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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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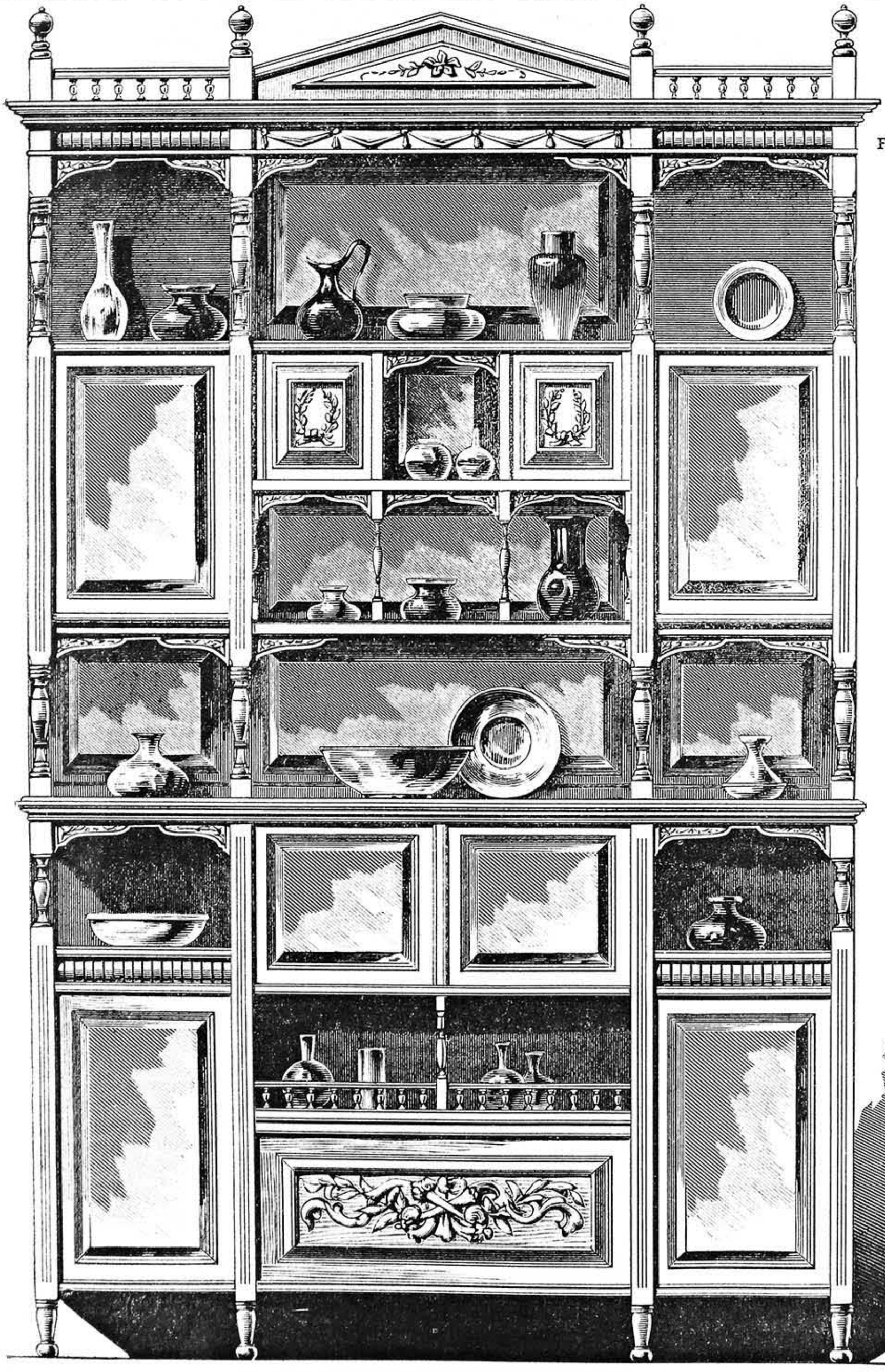

Fig. 1.—A Drawing-room Cabinet, Front Elevation. (Scale, 1 in. to 1 ft.)

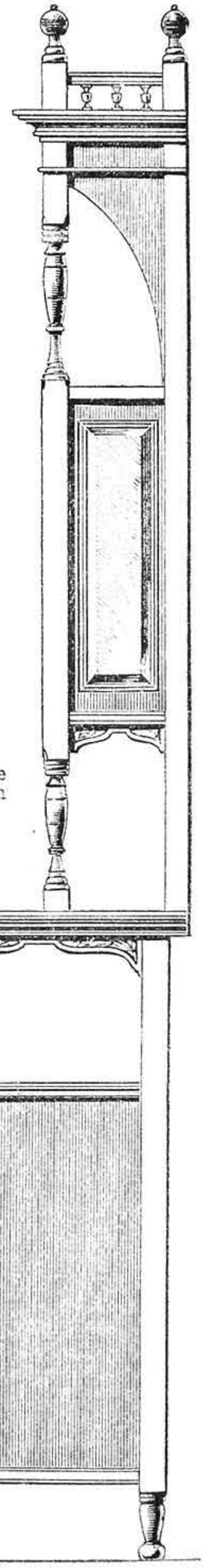

Fig. 2.—End or Side Elevation, on same Scale.

DRAWING-ROOM CABINET.

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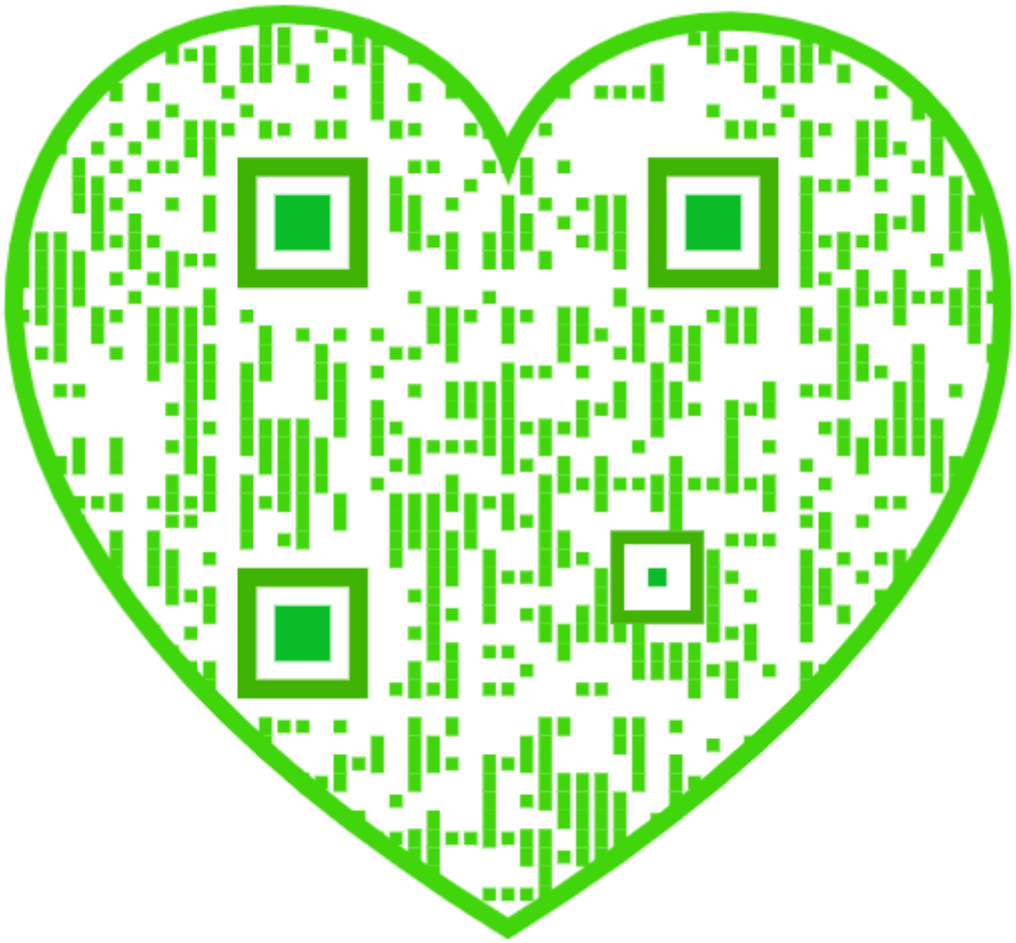

A DRAWING-ROOM CABINET.

BY A. T. HARTINGTON.

INTRODUCTORY — SIMPLICITY OF CONSTRUCTION— MATERIALS — DIMENSIONS — ANALYSIS OF ARRANGEMENT OF LOWER PART—OF UPPER PART — GLASS — LINING CUPBOARDS— FULL-SIZED DETAILS.

THE cabinet is to the drawing-room what the sideboard is to the dining-room—the principal piece of furniture, or at any rate the most imposing in appearance. Originally, no doubt, the cabinet was a small portable cupboard, which, as it developed, was divided into separate compartments, more, perhaps, for utility than for ornament. Now the arrangement of the cupboards forms an important part, even so far as appearance only is concerned, and a cabinet may not inaptly be regarded as an assemblage of small cupboards.

The one which forms the present subject, as will be seen from the illustrations, Figs. 1 and 2, the former showing the front and the latter the end elevation, is admirably adapted for the display of those knick-knacks for the reception of which a cabinet is primarily intended. It also forms in itself a useful and handsome piece of furniture, which, if properly carried out, represents considerable monetary value. Possibly many readers may be inclined to think it too elaborate for them to construct, and very likely they are right, for it is just the kind of job which requires a fairly expert maker, as unless made well the result would not be so satisfactory as if something simpler had been attempted. At the same time, I may as well point out to those to whom the apparent complexity may possibly cause a degree of hesitation, or a doubt that they could manage to make the cabinet, that there is really no difficulty about it. If they can make any single part, say one of the cupboards, separately, they can do the lot. The construction is really very simple and not beyond the ability of any fairly competent cabinet-maker. He will require more time, but little, if any, more skill than if he were making a small two-door cabinet. Neatness and accuracy must be studied, and if he does so he may depend on turning out a presentable piece of furniture.

Now, without going into details which would be needless to those who can make this job, a few hints may be acceptable.

Originally designed for, and made up in, Ameican walnut, with carved panels, as suggested, the cabinet is eminently suited for the fashionable rosewood, with marquetry substituted for the carvings, and inlaid stringings instead of the beads shown on the squares.

Figs. 1 and 2 are drawn to the scale of 1 in. = 1 ft., so that it will be seen that the principal measurements are as follows :— Width, 5 ft. ; height to top of lower part, 3 ft. 4 in., and over all, 8 ft.; depth from back to front, on top, 1 ft. 6 in., and 9 in. on the upper part, exclusive of the projection of the top moulding.

Analysing the design, the lower part is seen to consist of two end cupboards, with open space between them and the top ; in the centre a two-door cupboard, immediately under the top, and separated by an open space, with spindle-rail and turned column from the bottom cupboard, which is enclosed by a door hinged at the bottom and forming a convenient place for music or large books. The other cupboards have glass panels, either plain or silvered, as it may be desired to let the contents be visible or not.

The upper part, of course, is separate from the lower, and immediately above the top, in the back, are three silvered plates with bevelled edges—in fact, in a good job of this sort all the plates, whether transparent or silvered, ought to be bevelled. Above these plates are cupboards at each end, with a shelf on a line with their bottoms. Above this shelf, in the back, is a silvered plate, and immediately above it two small cupboards, with an open space between them, and with a glass at the back. Above the end cupboards the back, instead of being flat, is curved forwards to the top, or coved, the space between the coves being occupied by a glass at the back.

Other details will be seen more distinctly from the design, and few remarks about them will be necessary.

The end cupboards of the upper part are shown with transparent glass panels in the outer ends, and their backs should either be lined with velvet (plush) or with looking-glass. If a shelf is desirable inside, let it be of plate-glass with polished edges. The end cupboards of the lower part may be treated in the same way, but it is generally better to have the lower parts of cabinets, etc., more solid looking than the uppers. The principal details are given in the next page as follows :—

Fig. 3 shows one of the turned columns, all of which are the same in pattern, but vary in length according to their position. Above the turned part a sectional drawing gives the beading which is used on all the fronts of the squares, and by reference to Fig. 1 it will be noticed that they should be stopped.

Fig. 4 shows the moulding of the top, which the veriest tyro need hardly be told will be lined up, and not solid in the full thickness of the edge.

Fig. 5 gives a half-size representation of the moulding on top, together with its accompanying frieze. With regard to this a few remarks may be necessary. Above the coves it will be seen to be rounded and fluted as indicated in Fig. 5. As is, no doubt, well known to the majority of those who will make this cabinet, the rounded portion is simply planted on after having been turned in the lathe, and as four pieces will be required, two of them being in the lower portion above the end cupboards, they will be turned at the same time by being temporarily fastened on to a central block or core.

I do not think any practical cabinet-maker or joiner will experience any difficulty in carrying out the design, and, though I am not writing for novices or unskilled amateurs, if any of these intend to make the cabinet, and find there is some part of the construction which they do not understand, if they will state exactly where their difficulty lies I will endeavour to help them through "Shop." Vague requests, however, that they may be told how to make the cabinet, or any portion of it, will, however, hardly be worth noticing, so perhaps inquirers will please state just the points they want to know about.

It may be said that when it is completed the cabinet presents a splendid appearance, and will be found to be a handsome and comprehensive receptacle—if I may be permitted to use such a qualifying term in reference to the article of furniture now under consideration—for a fair percentage of the thousand and one things which collectors of bric-à-brac and curiosities generally delight to gather together, and with this I must quit my subject.

SHORT LESSONS IN WOOD-WORKING FOR AMATEURS.

BY B. A. BAXTER.

THE PLANE.

IN our second lesson we were introduced to the "winding strips" and their use ; we ought now to make the acquaintance of the trying plane. The jack plane, which we have hitherto used, does not give such accurate surfaces as the trying plane, because it is smaller, and also because it is not usually sharpened so carefully or its surface so well kept. The trying plane in general use is 22 in. long, the jack plane being usually 17 in. ; this shows that the trying plane is much superior in producing flat surfaces.

Having, by means of trying plane, winding sticks, and careful work, produced a flat surface, mark it ; for it is much less trouble to obtain true surfaces from the first than to employ winding sticks for each fresh surface ; therefore, whatever angle it is desired that the second surface shall have in relation to the first, it can be obtained by the use of a square or bevel, for if a surface is everywhere in the same relation to a flat surface, the second is also flat. When two adjacent surfaces are thus planed, and the angle correct, the other two surfaces are generally required to be parallel to the first planed. This is generally accomplished by using a marking gauge, and when the pupil can plane a piece of wood, the section of which, cut at right angles to two adjacent sides, gives four equal and therefore right angles, he will have achieved much in the way of mechanical manipulation.

There are other varieties of planes in constant use for special purposes, but enough has been said to suggest the fact that a plane is a copying tool : the iron cuts, and leaves the wood the counterpart of itself.

The next attempt in the use of the plane may be to try and plane the edges of two boards until they agree. This is difficult for a beginner, so I have said "attempt," but the effort cannot be anything but beneficial even if not quite a success. The material for this exercise may be two pine boards, 11 in. wide and 1 in. thick. They should be well supported in the bench screw and upon a bench pin in the sideboard, supporting the board at a convenient height ; from 3 ft. to 4 ft. will be a suitable length.

Another useful exercise in planing is to make a straight-edge or a plumb-rule. In doing this the use of the gauge is involved, but it has also this advantage : that it is a test for the performance of the trying plane. If the plane is slightly untrue, as sometimes will be the case, through violent changes of temperature or from continual use, the planing of an edge and the use of a gauge, followed by the use of the *same* plane in the *same condition*, will be a test of the state of the plane. Should it have been used for small work for some time the plane will probably have worn hollow, and will therefore make the edge of the board rounding, and all the efforts of the worker cannot make a straight edge ; on the other hand, if the plane has worn, as planes generally do, chiefly in front of the cutter, then the plane will be more prone to work "hollow," for the plane produces the counterpart of itself.

The beginner must not, however, attempt to correct his trying plane, but must obtain skilled help from a joiner or take his plane to a plane-maker, telling him what he considers to be the fault, and when it is returned, do not drive the wedge in so tightly as to strain the plane.

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HOW TO MAKE A QUARTER HORSE-POWER STEAM ENGINE.

BY F. A. M.

THE CROSSHEAD JOINT—CRANK-SHAFT—THE ECCENTRIC AND STRAP—THE ECCENTRIC AND VALVE-RODS.

FITTING CROSSHEAD JOINT—CENTRING AND TURNING THE CRANK-SHAFT—TURNING THE ECCENTRIC STRAP—CHUCKING AND TURNING THE ECCENTRIC—HOW TO TAKE UP WEAR IN THE BEARINGS—TURNING THE VALVE-ROD AND FITTING THE JOINT—PUTTING THE ENGINE TOGETHER AND ADJUSTING THE SLIDE-VALVE.

LET us now return to the crosshead and complete it. The first thing to do will be to file up the sides, or cheeks, of the upper part true with the hole, and bring it to 1 in. wide (see Fig. 8, page 328), so that it may fit between the sides of the fork of the connecting-rod. The little mandrel, *m*, of Fig. 53 (page 501), has been turned to the taper of the reamer used for cleaning out the hole for the crosshead pin; it will therefore fit into that hole projecting at both sides. Now, if on that mandrel we fit a little thick ferrule or annular disc of about 1 in. diameter, so that, while fitting on the mandrel, it can be brought up to touch one of the sides, it will form a guide for the filing just as the head of the crosshead pin did when we were working upon the fork of the connecting-rod. Take a bit of round iron or brass of about 1 in. diameter, and say 1 in. long, bore a $\frac{1}{4}$ in. hole through it, and try it on the small end of the mandrel, *m*, where it projects through the hole in the crosshead; if it will not go on, enlarge the hole in it with the reamer till it will go up into touch with the face of the crosshead; now take it off, drive out the little mandrel, and drive the little piece of iron on to it; put it thus in the lathe and square up both ends, or sides, of it; knock it off mandrel *m*, put mandrel into crosshead, and put the little piece on the projecting end, when it should fit the mandrel and come up into touch with the crosshead, so that you can use it to test the side of the crosshead and bring it true with the hole. The other side may be made parallel by means of the callipers, or the little ferrule may be bored a little larger with the reamer, so that it can be pushed further up mandrel *m*, and so be used upon the other side of the hole in the crosshead. The remainder of the crosshead may be filed up to look well, and the oil-hole at the top enlarged and tapped for the lubricator, when the crosshead may be oiled and laid aside.

We may now undertake the crank-shaft. A sketch of the forging supplied for this appears at Fig. 55. A round bar, 1 in. in diameter, is bent for the crank, and the flattened ends are turned up at A, A, to assist in the turning, which ends are afterwards cut off. The outer surfaces (*a b* and *c d*) may be roughly squared up first, and then the centres (*b* and *d*) found by placing the crank on the V's, marked with the centre-punch, square-centred in the lathe, and drilled up as usual for turning the crank-shaft, the arms, A, A, acting as carrier for the driver chuck. Next, a point-tool may be used to strike a circle on the ends of A, A, at *a* and *c*, just $2\frac{1}{8}$ in. from the centre of the shaft. When the arc is struck at *c* the tool would be withdrawn and the crank turned end for end, when it would be moved forward to strike an arc at *a* without otherwise disturbing it, so as to ensure the radius being exactly the same at each end. Do not on any account exceed the measurement of $2\frac{1}{8}$ in., or you will have to reduce the thickness of the piston or take other measures to prevent its knocking against one or both ends of the cylinder. The centres at *a* and *c* must be absolutely in the same plane as the centres *b* and *d*. To ensure this, try the forging on the surface-plate, and file the underside till it ceases to rock, and till the centres, *b* and *d*, both come opposite the point of the scribing-block. Now, with the point so set, scribe across the arcs previously marked at *a* and *c*; the points, *a*, *b*, *c*, *d*, will then be, all of them, equidistant from the surface-plate, and therefore they all lie in one plane. Countersink and drill the centres at *a* and *c*, and put the crank in the lathe to turn the main part of the shaft. Though the surfaces, *a b*, *c d*, are supposed to have been filed fairly square and true, yet it will be well, first, to turn them true in the lathe. The dimensions written on Fig. 55 are the forged dimensions, and give the size of the work before it is turned. In turning up the ends of the shaft and the arms, A, A, bring the extreme length to that written upon the drawing Fig. 5 (page 260), namely, $1\frac{3}{4}$ in. by 1 in. by $1\frac{1}{8}$ in. by $\frac{3}{4}$ in. by $1\frac{1}{8}$ in. by 1 in. by $1\frac{3}{4}$ in. = $8\frac{1}{2}$ in. When this is done, the end surfaces, *a b* and *c d*, will be used to measure from, and this will help us to get the necks for the two bearings, and that on the crank-pin, correctly placed. We may now proceed to turn the shaft on the centres, *b*, *d*. If the crank were weaker we should have to fit a bit of hard wood between the throws, or arms, of the crank; but this will hardly be required in the present case, except in square centring. Turn the main part at each end to $\frac{7}{8}$ in. full, leaving a little to come off at the final finishing, when the arms, A, A, shall have been cut off, and when the eccentric and fly-wheel are being fitted; turn the necks for the bearings, taking out the brasses and trying one of each pair upon the neck which is to turn in it, as it is quite essential the fit should be good, both as to diameter and as to the rounding of the corners. It is comparatively easy to make a fit when you can use one of the brasses as a gauge for your work as you turn the neck; whilst, if the shaft had been made first, it would have been very difficult. Take care to get the necks as smooth and round as possible, and well polished, then rub them over with marking, and rub the brasses round on them, to see whether they bear evenly; you may very likely find a little scraping necessary inside the brasses to make them fit perfectly. Having finished the main bearing necks, place the lathe centres at *a* and *c*, and turn the neck of the crank-pin in a similar way, trying the brasses of the connecting-rod upon it as before described. The crank-pin being thus finished, the arms, A, A, may be cut off with the hack-saw, the ends of the shaft turned, and, if desired, the arms or throws of the crank can be filed up and polished; or that part may be painted. The fly-wheel is supposed to be already finished, and to have a keyway cut in it $\frac{3}{8}$ in. wide and $\frac{3}{16}$ in. deep. The key should be of steel, as also that for the eccentric, which, however, need not be more than $\frac{5}{16}$ in. wide and $\frac{1}{8}$ in. thick. It would, of course, be more orthodox to sink a groove in the shaft instead of simply filing a flat as shown at Fig. 16 (p. 328); but this would require a slot-drill, and, by making the key for the fly-wheel rather wider than usual, it will hold the fly-wheel firmly if well fitted; the profile of the key for the eccentric is shown at Fig. 19 (p. 328). It and the larger one for the fly-wheel are about $\frac{1}{64}$ in. thinner at the point, so as to cause them to tighten up like a wedge, the bottom of the keyways being carefully filed to the same slope so that the key may bear equally hard all along its length. The fly-wheel

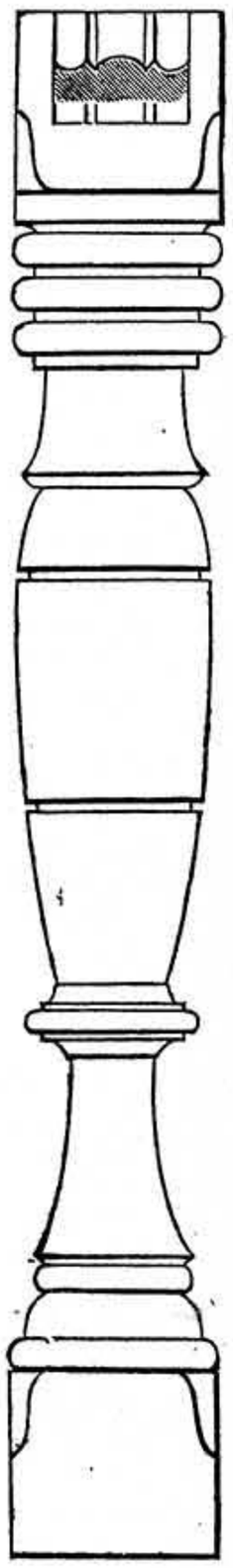

Fig. 3.—Pattern for Turned Pilaster (half size).

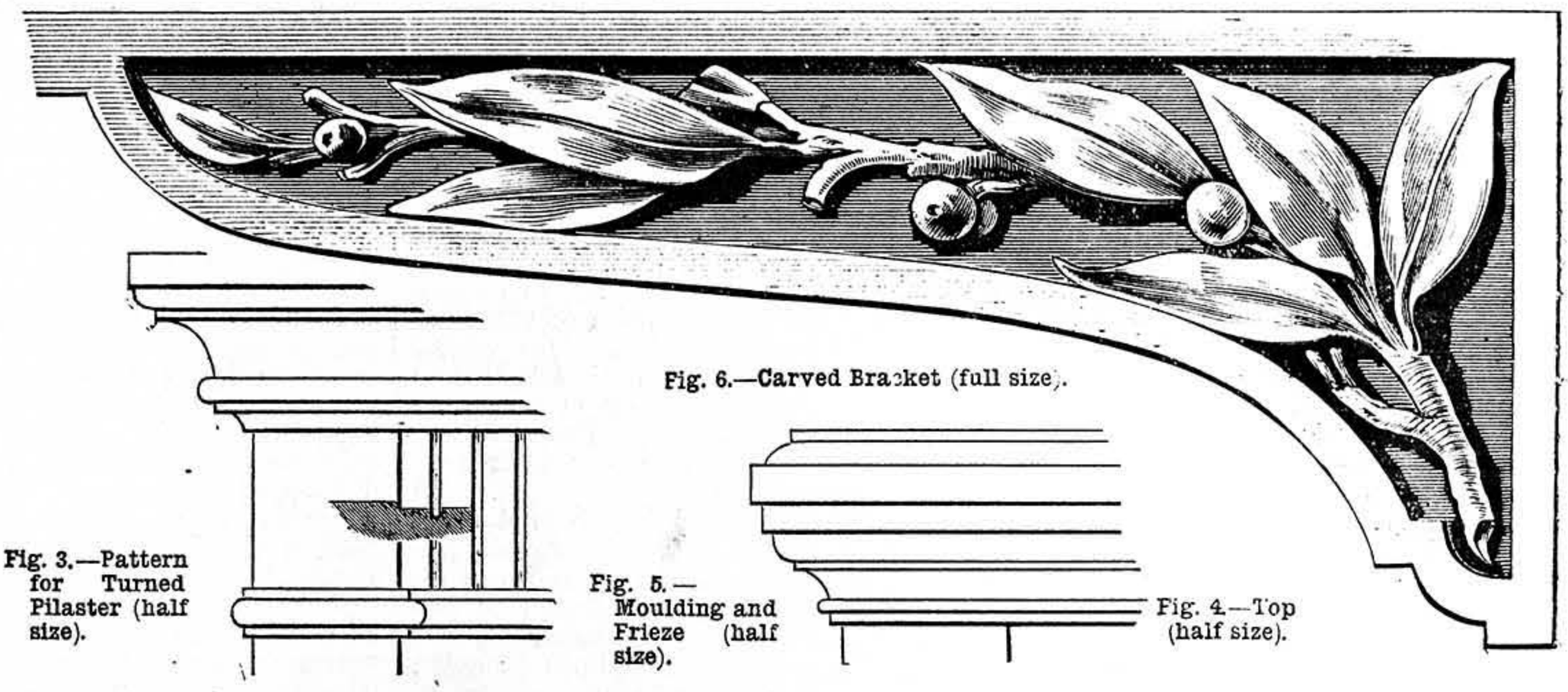

Fig. 6.—Carved Bracket (full size).

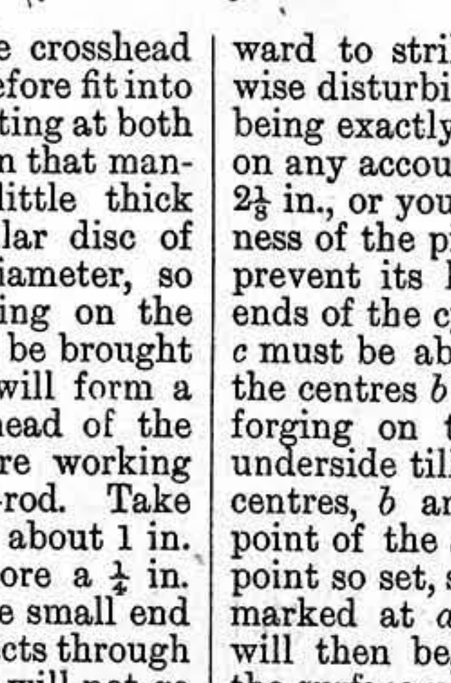

Fig. 5.—Moulding and Frieze (half size).

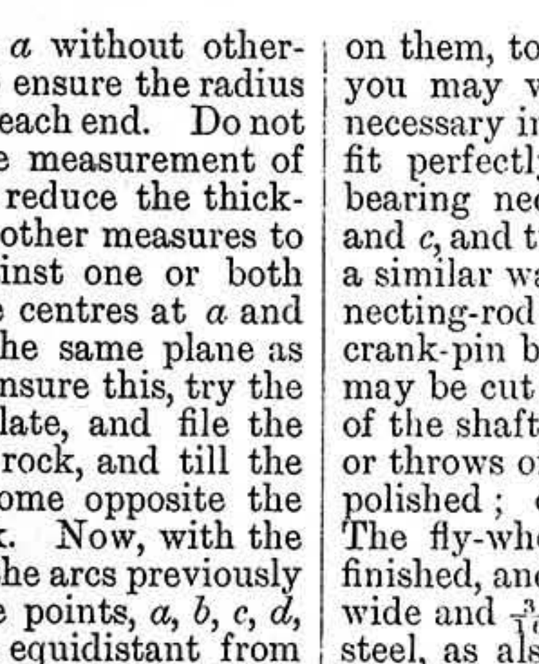

Fig. 4.—Top (half size).

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being bored, we may at once finish one end of the crank-shaft, and make it fit accurately into the wheel; it may then be laid aside till the eccentric is finished, since it is easier to fit a shaft to a hole than *vice versâ*.

Eccentric and Strap.—The eccentric and its strap may next be undertaken; they are shown in Figs. 16, 18, and 19, as well as in the complete views. The eccentric for the feed-pump is so arranged that it may be added or left out, according as it is required to have a feed-pump or not; it is shown, with its method of attachment, in Figs. 19, 20, and 21: it is simply bored out to fit upon the boss of the slide-valve eccentric, and fixed to it with two screws. Taking in hand the eccentric strap first, file up the ears, where the screws pass through, to fasten the two halves of the strap together. These four surfaces should be got up with the help of the face-plate, using a square to try whether the half strap stands up straight on the plate; the ears are $\frac{3}{8}$ in. thick. When, therefore, the four little surfaces have been filed true, set the point of the scribing-block to $\frac{3}{8}$ in. high, and, holding the half straps in one hand, scribe across the ears of both, on each side, a line $\frac{3}{8}$ in. above each of the four finished surfaces so as to mark the thickness of the ears, then file to these marks so as to get a flat surface for the heads of the screws. Next set the scriber point to $1\frac{5}{8}$ in., and mark off the large flat surface on the one half strap and the small one on the other. Tin the ears and solder the two halves of the strap together, then fit the screws and screw them firmly in. Now file one side of the strap, thus united, perfectly flat; screw a piece of hard wood on to the face-plate, chuck, and turn it true and flat; lay the flat side of the strap upon this and fix it by means of two dogs, in a similar way to that shown at Fig. 36, the dogs clasping only about $\frac{1}{8}$ in. of the ears, so that almost the whole of the front surface of the strap can be turned true; face up this front surface, bringing the strap to $\frac{1}{2}$ in. thick, and turn out the interior, observing carefully the dimensions in Fig. 18; scratch a fine line round, to which you can file the outside, and take the strap from the lathe to finish with the file. You can then chuck it again the reverse way to smooth and polish the first side, then melt the solder and separate the two halves. Now take the eccentric itself, grasp it in a universal chuck by the boss, bore the hole $\frac{7}{8}$ in., and cut or mark the key-way; fit it on to a mandrel (the crank-shaft would do, but mind it does not get bent when you hammer it on and off)—it must fit rather tight—put it between the centres, and finish the outside of the boss and the sides of the eccentric, bringing it to $\frac{1}{2}$ in. wide. To turn the outside of the eccentric we need a die chuck, but, failing that, can manage another way. Put on the face-plate chuck, with a flat piece of hard wood upon it, truly faced up; prepare another piece of hard wood $1\frac{1}{8}$ in. thick, or more, and about 5 in. by 4 in., with edges nicely squared up; put two long screws through the corners of this and screw it upon the middle of the first piece, sinking the heads of the screws below the surface, so that you can face it up in the lathe; now bore in the lathe a $1\frac{1}{2}$ in. hole in the centre of this piece, 1 in. or more deep, into which you can press the boss of the eccentric; the radius of the eccentric which joins its two centres must be placed parallel with two sides of the squared-up piece. Fig. 56 will make this plain: A is the face-plate; B, the first piece of wood; C, the second, in which the boss of the eccentric is fitted, the eccentric standing up on a line, *a b*, parallel with lines *c d*, *e f*, drawn on B. Now it is evident the two screws holding C to B may be taken out, and the piece C moved down $\frac{1}{2}$ in. along the lines *c d*, *e f*, and refixed there; thus the piece C acts like the slide of an eccentric chuck, and enables us to bring the sheaf of the eccentric true with the centre of revolution of the lathe, so that the outside of the eccentric can be turned. Lest the eccentric should move while being turned, owing to the boss turning round in the hole in C, an iron clamp, *g*, may be placed across the hole and secured by a screw passing through that hole into the wood. The half of the eccentric strap will, of course, be used to test the work, and the eccentric should be made to fit, both on the $\frac{1}{4}$ in. middle band, and on the smaller $\frac{1}{8}$ in. bands on each side of it, so that the eccentric may bear upon the whole $\frac{1}{2}$ in. width of the strap, an advantage this form of construction has over the older arrangement, where the strap works in a groove in the eccentric, which latter must then be the widest and, therefore, must take up more room on the shaft. When the straps wear, as they must do in time, as also the brasses of the connecting-rod, etc., they must be taken apart, and a little filed or scraped off the ears where the straps are screwed together, or off the brasses where they touch, until all looseness is gone and the fit is again perfect. If this is not done the engine will "knock" on each "dead centre"—that is, there will be a thump heard every time the piston changes its direction of motion. Whenever such a thing happens the cause should be sought for, and the noise stopped. An engine in proper order makes no knock or thump; the slightest noise of that kind suggests bad workmanship. Our engine should be quite inaudible in the next room; no one need object to have it in a room in the house if the workshop be so situated; its presence will not be suspected if it be kept in proper order.

The eccentric-rod and the valve-rod would seem to come next in order. A casting is provided for both. The valve-rod will require to be turned up, and draw-filed like the piston-rod, to avoid wearing out the stuffing; but, as it is only $\frac{3}{16}$ in. in diameter, it will require some kind of a back-stay to support it whilst being turned. When the shaft is finished to size the thread may be cut with stock and dies, taking care not to cut it too high up, so that the threaded part will be drawn into the stuffing-box. Then the nuts may be threaded in a three-jawed universal chuck, and trued up in position on the rod.

The joint is the only remaining point which need delay us. File up first that part which belongs to the valve-rod. It requires to be $\frac{1}{4}$ in. thick; and the flat surfaces on each side to be parallel with the centre line of the rod, and equally distant from it. These conditions can be simply ensured by pressing one of the surfaces down upon the surface-plate, so that the length of the rod is supported in the air, when it will be easy to see whether it is parallel with the plate or not.

When this part is satisfactory file up one side of the joint on the eccentric-rod, taking care that it is parallel with the length of the rod, and "out of wind" with the flange at the large end; then file the other three surfaces of the joint to this first one, as before described for the fork of the connecting-rod. Bore both parts of the joint with a $\frac{1}{4}$ in. drill, put them together, clean out the hole with a $\frac{1}{4}$ in. reamer, and turn the pin of cast steel to fit. Then harden both parts of the joint with prussiate of potash, harden the pin, and grind it in with emery powder. Clean off the emery, and the joint is finished.

No directions appear to be needed for fitting the flange at the larger end to the eccentric-sheaf; and the eccentric-rod itself may be got up bright, draw-filed, and finished with emery-cloth, or it may be simply left rough and painted.

Putting together the Engine.—It will be well at this stage to fit the parts, thus far finished, together.

The cylinder being bolted to the bed-plate, the piston and rod in place, the crosshead and guide plates fixed, put the crank-shaft into the two bearings, and put the connecting-rod on to the crank-pin, and, after laying these parts on the bed-plate, bring together the fork end of the connecting-rod and the crosshead, passing the pin through, and securing the joint. Push the piston to the bottom of its stroke, as it appears in Fig. 5; place the crank horizontal, and mark on the bed the position occupied by the soles of the two crank-shaft bearings. Now turn the crank half-round, pulling out the piston to the end of its stroke. Set the crank again horizontal, and mark again the position of the soles of the bearings on the bed-plate. This position should be the same as before, but if the bearings have moved a little in the direction of the length of the bed, you have only to place them in an intermediate position, so as to split the difference; scribe through the bolt-holes in the feet of the bearings on to the bed, drill and tap these holes, fix the four studs, and bolt the bearings down on the bed.

The brasses of the large end of the connecting-rod having been clasped on, the crank-pin should suffice to place the crank-shaft fairly at right angles with the centre line of the engine. Any error that might arise would be eliminated by splitting the difference between two positions. The studs which secure the bearings should fit fairly well in the holes, so as to act partly as steady pins.

Now you may as well file a flat on the crank-shaft, and make the key to secure the fly-wheel. Fit this carefully, and drive it in pretty firmly, and you can then turn the engine round by the wheel. Try it round to see whether it moves evenly, or whether it sticks or moves stiffly at any point. If it does, seek what is wrong by taking off one thing after another, till you find what is tight.

For instance, you might disconnect the crosshead joint, and try the three brasses on the crank-shaft alone. Suppose there is still a tightness, then you could loosen them one by one, then tighten one at a time, turning the wheel every now and then.

Your aim should be to have the bearings all equally tight, so that the shaft can freely revolve without much friction, and yet without being loose enough to knock. However, there is sure to be a slight stiffness in a new engine, which will wear off by-and-by.

We could prevent this by grinding in the joints, but if we did so there would probably remain in the bearings a little of the sand, which would cause them to wear away continually, so that it is a dangerous thing to advise. A shaft may be ground in with emery if, like the mandrel of a lathe, both it and the collar, or bearing, are left "dead" hard—because emery powder cannot get embedded in hard steel. A joint or bearing of iron or brass would be ruined if ground together with emery, because the emery could never be got out again. A

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joint of brass or iron can be ground together with the grit from the grindstone trough, if, like the plug of a tap, it is only moved occasionally; but if, like the bearings of our engine, the shaft is to turn continuously, it is better to trust to scraping out the brasses where they seem to bind, and to keep all abrasive powders far away.

Having now, thus far, put together or erected the main parts of our engine, we will proceed to adjust the slide-valve. Pass the valve-box over the studs, and, leaving off the cover for the present, put in the slide-valve, and pass the valve-rod in through its stuffing-box; two nuts, slide-valve, and two more nuts, locking these in pairs on each side of the valve. Now connect the eccentric-rod with the valve-rod and with the eccentric, this latter being in its place on the shaft, but not keyed—the keyway being cut in it, and fitted with a temporary key bearing upon the round shaft, on which the flat has not yet been filed. Place the piston in the position shown in Fig. 5, the crank being horizontal, and the piston at the end of its stroke. Now turn the eccentric round upon the shaft till it points upwards, and away from the cylinder, in the position shown at Fig. 16, making an angle of about 120° with the crank. The valve should now be just beginning to uncover the port leading to the bottom of the cylinder, as it is seen in Fig. 5.

If this is not the position of the valve, that will be owing to one of two causes: either the angle of the eccentric is not correct, or the length of the connection between the eccentric and the edge of the valve is not exact. Turn the eccentric on the shaft till the valve uncovers the edge of the port, so that you can get in the corner of a visiting card. That distance is called the lead of the valve, as explained in the introduction. Fix the eccentric by the temporary wedge, and turn the crank just half-way round, till it stands level, whilst the piston is at the opposite end of the stroke. Now, the valve, to occupy the proper position, should be uncovering the other port by the same distance, and then we should say the lead was equalised; this, however, is not likely to be the case till the length of the eccentric-rod, etc., has been adjusted.

Let us suppose the valve, instead of having only just opened the port, has opened it by half its width—*i.e.*, it has moved too far by $\frac{1}{8}$ in. This would prove the eccentric and valve-rods were too long by half that distance. Now, we can shorten the effective length of the valve-rod by moving the nuts. Move these nuts, then, so as to diminish the excessive travel of the valve by one-half of $\frac{1}{8}$ in., so that, without moving the other parts, the valve shall be open but one-quarter of the width of the port. Now loosen the wedge of the eccentric, and turn it round on the shaft till the valve is open by the thickness of a card, fix the eccentric by the wedge, turn the crank round to the first position, and observe the valve, when we should find the lead is about right. Enough has now been said to show how the lead can be equalised, and the proper angular position for the eccentric found. When this has been determined, mark on the shaft the position of the keyway of the eccentric, and take off the eccentric to file the flat on the shaft for the permanent key. When the key is being finally fitted test the lead again, to make sure you have the flat filed just right: it is easy to adjust with a flat on the shaft, a thing that cannot be done with a sunk keyway.

A FEW PHOTOGRAPHIC EXPEDIENTS.

BY AN OLD HAND.

When almost everybody, gentle and simple, turns or tries to turn photographer, there are necessarily some to whom the good things of this life have been meted out with a sparing hand, and to such a few hints of how to make most of a little will perhaps be acceptable. There are two things without which it is impossible to take a photograph satisfactorily. A cigar-box and a pin-hole is all very well for those of the impressionist school, but for real practical work there is a *necessity* for a *camera* and *lens*. Although the cost of these articles has, during the last few years, been marvellously reduced, still, if the would-be photographer has to buy them, and requires good things of the kind—things that will bear some wear and tear—he must put down a certain amount of cash, that may not at all times be conveniently found. I would advise such to try and manufacture their own lenses and cameras—not so difficult a matter as appears at first sight. An article, or rather a series of articles were published in early numbers of Work, giving directions how to make a camera of a thoroughly good pattern at a much less cost than it would be possible to purchase one of a similar kind. A rough substitute for a camera could, of course, be knocked up with hammer, nails, wood, and bookbinder's cloth, but such are not worth the labour bestowed upon them. The failing of almost all cheap apparatus is its liability to get out of order and the wearing out of important parts. It is better by far to have an old pattern well-made thing than a common modern one with all its multifarious movements—that is, supposing one is purchased, but my advice is make them yourself. Now about lenses. In the spring of this year a Mr. Lionel Clarke read a paper at the Camera Club, giving the results of his experiments with *spectacle lenses*. This paper was published in most of the photograph literature at the time, and it is to this I would call special attention. A long time prior to this I had made use of this device in an emergency, and can fully bear out most of Mr. Clarke's assertions, and go yet further by attributing better qualities to such lenses than he felt inclined to concede. The first question is, What sort of spectacle lenses are to be used? as they vary so much in kind and quality. The answer is: get lenses of the periscopic form—that is, convex on one side and concave on the other, the curves on each side being different, the inside curve following the lines of a large circle, and the curve of the convex, or outside, that of a smaller one; the proportion of these curves to each other determine the focal length of the lens. Spectacle lenses of this form are generally used for old sight, and vary in focus considerably. They can be purchased separately at a lens dealer's, at a price from threepence each for ordinary glass and about fifteenpence for one made of pebble: the gradations of focus are, I believe, by two inches—26, 24, 22, etc. Now, for photographic purposes the use of these lenses singly is not altogether convenient. In the first place, the lines of the image are not straight, and the area of good definition is small compared with the length of focus; we therefore adopt the plan of placing two together, with the concave or hollow sides towards each other, with a very small stop between them. The small amount of light passing through such an opening makes it difficult to focus with unless on a very strongly illuminated subject; therefore, for convenience to the amateur in making such a lens, the stop may be placed close in front touching the lens. The focussing and arrangement of the subject may be done without the stop, which can be inserted afterwards. There will be only a very small portion, if any, of the picture absolutely sharp without the stop, but it will be remedied by its insertion. There are two kinds of foci in uncorrected lenses, called the optical and visual. The optical one is the one that forms the image on the sensitive plate, and the visual one is the one we see on the focussing screen in properly corrected lenses, such as the best sold for photographic work. These two foci are made to fall on the same plane, consequently, if the image looks sharp it photographs sharp; but with spectacle lenses it is not so, and this peculiarity has to be taken

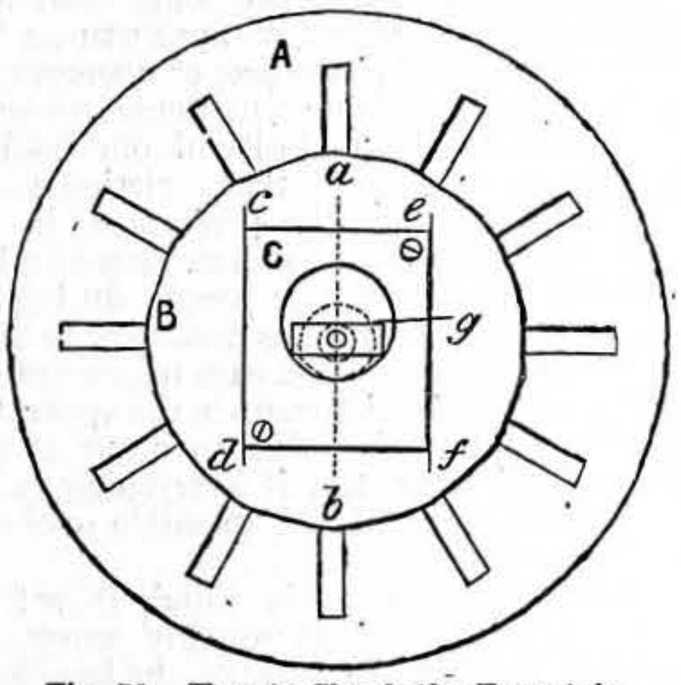

Fig. 56.—How to Chuck the Eccentric.

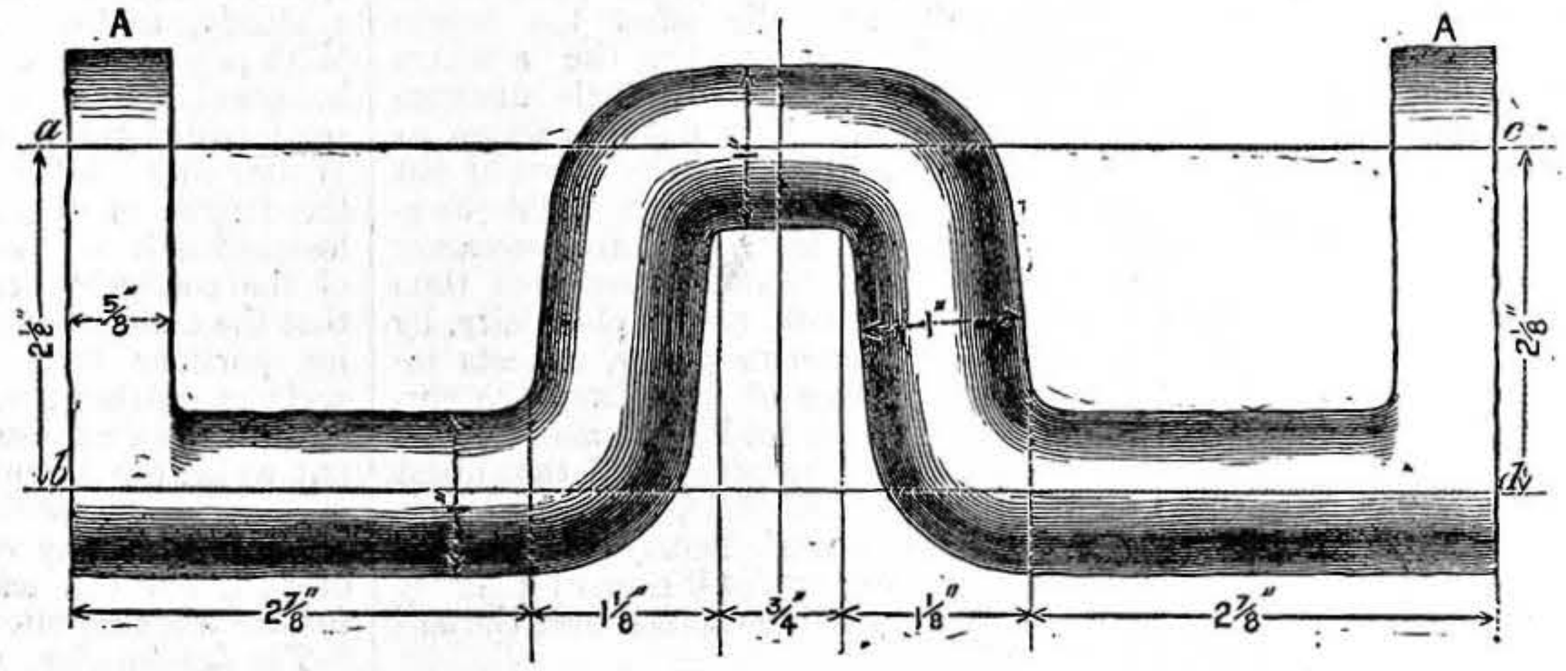

Fig. 55.—Sketch of Forging for Crank, with Dimensions of Forging.

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into consideration. The optical focus, the one we want, is about a fortieth of the length of the focus of the lens *shorter* than the visual, which means that with a combination of lenses having a focus of ten inches, the plate will have to be just a quarter of an inch *nearer* the lens than the distance that gives the sharpest image on the focussing screen, therefore in focussing prepare for a distant object in preference to one in the foreground. Knowing this much, we will put a lens together suitable for a picture whole-plate size, or less. First of all there is the tube or lens mount. Very often an old discarded tube may be had at the dealers in, or repairers of, photographic lenses. If this cannot be had, two short pieces of brass tube about an inch long and three-quarters of an inch in diameter will answer the purpose; a flat ring to act as a flange, with a thread turned on the inside suited to threads turned on the ends of the tubes, will be required to fix the lens to the camera. We now procure a couple of the periscopic spectacle lenses, made of pebble by preference, as the surface is harder and better in all respects than glass of twenty-four inches focus. Fasten them together, hollow sides inwards, with a little gummed paper round the edges; they must be exactly centred by placing the edges accurately together. Now make a disc of cork to fit accurately into the brass tube with a round hole in the centre, half an inch in diameter, in which the lens is to be fixed; the oval shape of the lens may be reduced by cutting it with a diamond and chipping off with a pair of good pliers; at any rate, the lens must be fixed upright in the tube—that is, at right angles with its sides—so that a stop made of thin metal, the aperture to be $\frac{1}{16}$ in., can be put in close contact with the glass; and in front of it another stop, with an aperture of $\frac{1}{32}$ in., will sometimes be useful. Any other means may be devised to fix the lens in position; so long as it is in the right position, the means by which it is done is immaterial. It will be found that when two lenses of equal foci are placed together the focus will be reduced by half—that is, the 24 in. will become 12 in.; add another lens of 24 in., and the focus will be reduced to 6 in. The focus will always be found to be nearly half that of the shortest focus, whether formed by a combination of lenses or single lenses. In the combination just referred to—two 24 in. to make a 12 in.—this forms a moderate angle view on a whole plate, and comes well to the corners. If we take a 24 in. lens and fix to it one, say, of 16 in., we have a much wider angle lens of a shorter focus; the variety of foci differs with every different lens used, and it is easy to make a combination to suit the purpose for which it is required, bearing in mind the longer focus lens should be the outside lens, and that the position of the stop not only regulates *the definition* but the size of the image. The more in front the stop is placed—that is, the further from the lens or front—the smaller the *area* of the image, and *vice versâ*. This indicates that a stop *between* the two lenses is the best place for it, as there we get a maximum of area and of definition. It may be thought that with such small stops the time of exposure would be enormously prolonged; it is not so, however, as compensation is afforded by the very trifling absorption of light of the thin media through which it passes. The lens just described would take a thoroughly exposed picture in an average light with the $\frac{1}{16}$ in. stop in five seconds, which is not abnormally long, with plates like the Ilford ordinary. With very rapid plates and a suitable sea-side subject the exposure, in spite of the small aperture, would be instantaneous. At any rate, I have said enough to enable anyone of constructive ability to make a thoroughly good working lens that will take pictures equal to the most expensive kinds, and at an exceedingly small outlay.

THE WINTER ELECTRICAL MACHINE AND ACCESSORY APPARATUS.

BY CHAS. A. PARKER.

PREPARATION OF MACHINE FOR WORKING—ELECTRICAL AMALGAM—LEYDEN JAR—DISCHARGING ROD — DIRECTOR — JOINTED DISCHARGER — LEYDEN BATTERY—DIAMOND-SPOTTED JAR—SPORTSMAN JAR — LANE'S DISCHARGING ELECTROMETER—SPIDER JAR.

BEFORE passing on to the consideration of other accessory pieces of apparatus, a few hints with regard to the proper management of the Winter machine will doubtless prove acceptable to the majority of our readers. Owing to the fact that frictional experiments are usually performed in the winter-time as a means of amusement and instruction for the young people during the long evenings, it becomes necessary to exercise the greatest possible care to prevent the condensation of moisture upon the apparatus, which is extremely liable to occur at this time of the year, for, if everything is not perfectly dry, it will be impossible to obtain uniformly good results.

Bearing the above in mind, it will be found advisable to thoroughly warm the machine previous to turning the handle, as any moisture conveyed by the plate to the rubbers will materially affect the results obtained. For this reason the machine should be placed at some little distance from the fire before it is put into action, as this precaution will have the effect of disseminating any moisture which would otherwise form on the plate. It is also necessary to carefully wipe the machine each time before it is put into use, as electricity, by virtue of its attractive power, collects innumerable particles of dust from the surrounding air, which act like so many points on the plate being revolved, and thus assist to dissipate the electricity as fast as it is generated. The electricity may be developed to a much greater extent if a small quantity of electrical amalgam is spread over the face of the rubbers.

Electrical Amalgam is a mixture composed of mercury, tin, and zinc, and can be obtained from any electrician, ready for use, at about 6d. per ounce, or, if preferred, it may be readily made in the following manner by the student himself: Melt together five parts of zinc and three parts of tin, and then pour nine parts of heated mercury on to the melted mass, and stir the whole together thoroughly. It is now poured into an iron or wooden box, and shaken up well until quite cold, when it should be collected and reduced to a fine powder, after which it may be placed aside in a convenient box or wide-mouthed bottle ready for future use. A small portion of the powder should be mixed up with lard in the form of a thick paste as required, and then smeared over the face of the rubber by means of an old knife. No more lard should be employed than is absolutely necessary in order to make it adhere. When it is wished to remove the rubbers from the holder, the plate should be given a few turns in the wrong direction, which will cause them to come out readily. A thin, even coat of amalgam may then be spread on the face of each one, after which they are returned to the holder.

To do this, hold them in position, one on either side of the plate, with the springs pressed down, and then push them forward with the plate until they are in the holder.

If the handle of the machine is now turned with a uniformly steady motion, the positive electricity will be driven over the surface of the prime conductor, from whence it may be drawn in the form of a bright spark; but, assuming the rubber and the prime conductor to be in their present insulated condition, the sparks will gradually become weaker and weaker, until at last they will cease altogether when the electricity of the plate has become exhausted.

In order to secure a continuous supply of electricity, it becomes necessary to connect the rubber with the earth by means of a length of chain attached to the nearest gas- or water-pipe. A suitable length of Dutch clock chain will be found to answer admirably for this purpose. Chain of this description, having small links the size and shape of Fig. 19, can be obtained from any watch and clock tool warehouse at about 3d. per yard; or, if preferred, the rubber can be connected with the earth by means of spirals of thick copper wire. When the machine is in use, it should be located on a table, quite clear of surrounding objects, as these will only tend to weaken the discharge by imperceptibly drawing off the electricity. It will also be found an advantage to clamp the machine firmly to the table, as it will then allow the student to work with greater freedom. It is a distinct disadvantage to work the machine at an express rate of speed, as the best results are obtained when a steady, uniform motion is maintained. With proper and careful management it will be possible to take 6 in. sparks from the small ball of the prime conductor when the Winter ring is attached to the machine, but the length of spark will be considerably lessened if it is drawn from the large ball of the conductor itself, owing to the fact that the tension is always greater at projecting portions than at approximately flat surfaces. After use, the rubbers may with advantage be removed and wrapped up and put away, the machine also being covered over. This precaution will have the effect of preventing any very great accumulation of dust, and will leave the machine ready for use when required.

The Leyden Jar, which is illustrated in Fig. 20, may be said to be one of the principal pieces of apparatus used in conjunction with an electrical machine. It takes the form of a thin glass jar or wide-mouthed bottle, which is lined inside and out with tinfoil, and provided with a wooden cap, through which a metal stem passes into the interior of the jar for the purpose of charging it with electricity. The lower end of this metal stem is furnished with a few inches of chain or a strip of thin sheet-brass, in order to make contact with the inner coating, and the upper portion terminates in a knob outside the jar, for, without this precaution, the electricity would be liable to escape from the end of the rod. The Leyden jar can, of course, be made to any size desired, but for all ordinary purposes a jar measuring about 12 in. in height and 8 in. in diameter will be found a useful size, sufficient for all ordinary purposes. Select a perfectly sound glass jar, entirely free from all cracks or imperfections, then proceed to coat the interior with tinfoil cut into strips about a couple of inches wide and of a suitable length to reach from the

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bottom of the jar to within 2 in. from the top. The pasted strips of foil must be carefully introduced into the jar, and then made to adhere to the side by means of a small mop, which can be readily made by tying a piece of wadding on to the end of a strip of wood. Each succeeding piece of foil should be made to slightly overlap the preceding one, until the entire surface inside the jar has been completely covered, when a circular disc of foil a trifle smaller than the inside of the jar is cut and pasted over the bottom, thus completing the arrangements of the interior. For the outer coating, a single strip of foil of suitable size should be pasted and wrapped completely round the outside, with the edges slightly overlapping, not omitting to turn a narrow margin underneath at the base, after which the coating is completed by a suitable-sized disc of foil pasted on to the bottom. It is highly important for the outer covering to be laid on perfectly smooth and entirely free from creases or wrinkles, as, being open to inspection, any slipshod details will show with damaging effect. It is almost needless to say the two coatings should be of a uniform height.

For the rod we shall require a piece of stout brass rod, about $\frac{1}{8}$ in. thick and a third longer than the total height of the jar. A narrow strip of thin sheet-brass, a trifle longer than the width of the jar, is now bent to the form of A, Fig. 21, and afterwards drilled through the centre, and then fitted and soldered on to the end of the rod, after which the latter is made to fit tightly into a hole bored through the centre of an ornamental lid or cap (B, Fig. 21), which is turned to a suitable size proportionate to the jar. Four small slips of cork, glued round the under edge of this wooden cap, will ensure the latter fitting tightly to the mouth of the jar. The cover, which should be turned from a piece of thoroughly dry mahogany, will require to receive two or three coats of good shellac varnish for the purpose of better insulation. An ordinary brass stool ball of suitable size will be found to answer very well for the knob of the jar. These balls, which can be obtained from any ironmonger, are provided with short screw stems soldered to the inside of the ball. It will be found a simple matter to heat the ball over a gas flame and melt out the screw, and then solder it to the end of the rod, thus forming the knob of the jar. After the stem and knob have been carefully lacquered, the brass spring should be pressed together slightly, in order that it may just pass through the neck of the jar; then the rod is steadily pushed downwards until it touches the bottom, when the strip of brass will adapt itself to the form of the jar, and thus ensure metallic contact with the inner coating of foil. A great many jam manufacturers are now using wide-mouthed jars made of hard, white glass of good quality, similar in shape to Fig. 20, which are admirably suited for use as Leyden jars, as the mouths are almost the width of the jar itself, which thus renders the attachment of the inner coating a very simple matter. The writer has seen these jars in two sizes, of $\frac{1}{2}$ lb. and 1 lb. capacity, measuring outside 4 in. by 3 in., and $5\frac{1}{2}$ in. by $3\frac{1}{2}$ in., respectively.

A Discharging Rod is a very useful appliance, which is used for the purpose of discharging a Leyden jar when it is undesirable for the experimentalist to receive the shock himself. The discharger takes the form of a stout piece of brass wire about 12 in. long, which is bent in the form indicated in Fig. 22, and then inserted in a 1 in. length of brass tube $\frac{5}{8}$ in. in diameter, to which it is secured by means of soft solder. Two small brass balls are now soft soldered to the ends of the brass arms, after which the central socket is cemented on to the end of a 6 in. length of $\frac{1}{2}$ in. glass rod, which forms the handle. The width apart of the arms can be regulated to suit requirements by bending each one to the form desired. The piece of glass required for the handle may be broken from a larger rod, if a slight groove is first made round the rod by means of a file, after which the lower end should be rounded off on a grindstone. Another plan of making this discharger is to cement a small brass gas cap on to the end of the glass rod, and then insert the wire in a couple of holes of suitable size drilled through the cap on opposite sides as shown in Fig. 23.

A Director (shown in Fig. 24) is another form of discharger, which will be found very useful when discharging a Leyden battery and in manipulating various other pieces of apparatus. It consists of a 6 in. length of stout brass rod, which is soldered into a hole drilled in the end of a small brass gas-tap, and then cemented on to a 6 in. length of glass rod, after which the outer end of the brass rod should be bent in the form of a curve, and provided with a small brass knob.

The Jointed Discharger (illustrated in Figs. 25 and 26) will be found much more useful for all ordinary purposes than either of the foregoing, as the width of the arms can be accurately adjusted to the purpose for which they are required. A couple of pieces of stout brass rod should be softened in a gas flame, and then bent in the form of a loop at one end, which is afterwards flattened out on an anvil in order to spread the metal as much as possible. Thus prepared, the two arms are placed together, with a small washer in position on either side, in order that they may be joined together by means of a small brass nail passed through a central hole in the washer, and then riveted up tight, so that the arms may move stiffly. A couple of brass gas caps, $\frac{3}{4}$ in. diameter, are now procured from a gas-fitter, and provided with a couple of holes, which are drilled across the diameter of each cap near to the closed end. When this has been done, each cap is tightly fitted on to one of the jointed arms, and then soldered in position at about an inch from the joint. A couple of 4 in. lengths of glass rod of suitable diameter are now cemented into these caps, thus forming the insulating handles by which the discharger is held—a small brass ball being lastly soldered on to the end of each arm.

The Leyden Battery (which is shown in Fig. 27) will be found indispensable for the performance of certain experiments—when it is desirable to pass a powerful discharge through a body, or for the purpose of fusing or igniting various substances. The Leyden battery is formed by connecting the internal and external coatings of four or more jars, in order to render it possible to pass the full discharge from all the jars at the same instant. A wooden box of sufficient size to hold the jars, and about 2 in. less than the total height of one of the latter, is provided with four supporting feet, and then French polished or varnished outside, after which the interior is carefully coated with tinfoil, and a brass drop handle is lastly screwed on to either end. Thus prepared, the jars may be placed in the box as required, the knobs which represent the inner coatings being connected together by means of a piece of brass chain, which is twisted round each jar. The Leyden battery is charged and discharged in precisely the same manner as a single jar. The inner coatings are put in communication with the prime conductor by means of a suitable length of chain brought from the knobs of the jars and hooked on to the latter, and the necessary earth contact is obtained by suspending a short length of chain from one of the handles. These handles, by the way, should be in metallic contact with the inner tinfoil coating of the box. This arrangement of Leyden battery will be found very useful when the jars are frequently used singly; but, supposing that several jars are kept solely for use as a battery, it will be found a good plan to connect the inner coatings together by means of cross rods of stout brass wire, which are sprung into holes drilled for their reception in the knobs of all the jars, as will be seen by reference to the cut.

The Diamond-spotted Jar (illustrated in Fig. 28) forms a very beautiful experiment when the discharge is viewed in a darkened room. The tinfoil with which the jar is covered is cut in the shape of small 1 in. squares, pierced with a central opening about $\frac{1}{2}$ in. in diameter. Each piece of foil should be punched separately, whilst supported on a block of hard wood, using a $\frac{1}{2}$ in. cork borer for the purpose. When a sufficient number of pieces of foil have been prepared, it will be time to begin coating the jar, commencing with the lower conducting surface. For this, first lay a disc of foil of suitable size over the bottom on the inside, and then paste a $\frac{3}{4}$ in. strip of foil round the sides and in contact with the disc covering the bottom. Thus prepared, the small discs of foil are carefully pasted on to the glass with the diagonals of the squares horizontal and vertical, and arranged in such a manner that the points nearly touch one another, as shown in Fig. 29, which is an enlarged detail of the coating, the shaded discs representing the inner coating. When a sufficient height for the coating has been reached, another narrow strip of foil should be pasted all round the top, after which the outside of the jar is coated in a precisely similar manner—a narrow strip of foil being pasted at the top and bottom in a corresponding position to the strips on the inside, with a circular disc of foil covering the bottom of the jar. The points of the outer discs of foil should be so arranged as to nearly touch each other in the centre of the opening of the inside pieces. By this means the sparks will be seen to simultaneously illuminate both the inside and outside on the jar being discharged. When the jar has been coated in a satisfactory manner, it should be furnished with a sound, dry, wooden cover, which is then varnished and fitted with a brass stem and ball in the manner before described. On the jar being charged, bright little sparks will be observed scintillating all over the surface when viewed in a darkened room; and when the discharge takes place, a beautiful bright spark will appear at the same instant at each angle over the entire surface.

The Sportsman Jar (which is shown in Fig. 30) forms a very amusing and interesting piece of apparatus, which is by no means difficult to construct. First solder a small brass ball to one end of a short length of stout brass rod, and then bend the latter to the form indicated in Fig. 30, at A, and afterwards solder it at about two inches below the knob of an ordinary Leyden jar, in the manner shown in the above cut. When

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this has been done, carve a small wooden figure about the height of the jar to represent a sportsman with a gun at his shoulder, and then paint the figure in suitable colours, after which a small wooden stand, shaped in the form indicated in the cut, should be carefully moulded on which to stand the jar and the figure, the latter being attached to the base by means of a couple of screws and some glue. Before finally fixing the figure to the base, it will be necessary to polish or varnish the latter, and then cover the entire upper surface with a sheet of tinfoil cut to the required shape and then pasted on the wood — any wrinkles or creases being smoothed down flat by means of a piece of wadding or cotton-wool. Two or three pieces of pith are now cut to resemble birds, and then attached to the extended arm of the jar by means of silk threads, after which the apparatus is finally arranged in the manner shown in Fig. 30. The gun should be placed in metallic contact with the outer coating of the jar by means of a strip of foil led from the gun down the side of the figure to the foil-covered base, and the gun—which may be made of metal—should be furnished with a small knob at the end. On the jar being charged, it will cause the birds to rise and fly as far away from the central knob of the jar as the length of the silk threads will allow, and, as soon as the jar has become fully charged, a spark will pass from the knob of the jar to the gun, thus discharging the jar and causing the birds to fall as though shot. Small carved Swiss figures, suitable for this purpose, can now be obtained from any toy-shop at very reasonable charges, and one of these can generally be found which will answer the purpose with but slight alteration.

Lane's Discharging Electrometer (shown in Fig. 31) is a very useful appliance for regulating the sparks given off by a jar, and is almost identical in principle with the Sportsman jar, above described. First obtain a pair of small brass bedstead knobs, and then drill a hole on opposite sides through the centre of each one. When this has been done, one of the knobs should be tightly fitted on to the stem of an ordinary Leyden jar, to which it is affixed, about midway between the knob of the jar and the wooden cover of the latter, by means of a touch of soft solder. A 6 in. length of stout brass rod is now bent in the form of a ring at one end, and then made to fit tightly into the holes drilled through the other knob, after which a small brass ball is soft soldered on to the straight end of the rod. The rod will not require to be soldered, but should be arranged in such a manner as to move stiffly through the knob. Thus prepared, an 8 in. length of soft glass tubing of suitable diameter to fit the open ends of the two knobs is now softened in a Bunsen flame and then bent up to right angles at about a couple of inches from one end, after which the short arm of the glass tube is cemented into the knob provided with the adjusting rod, the remaining end of the glass stem being attached in a similar manner to the knob of the Leyden jar.

Fig. 19.

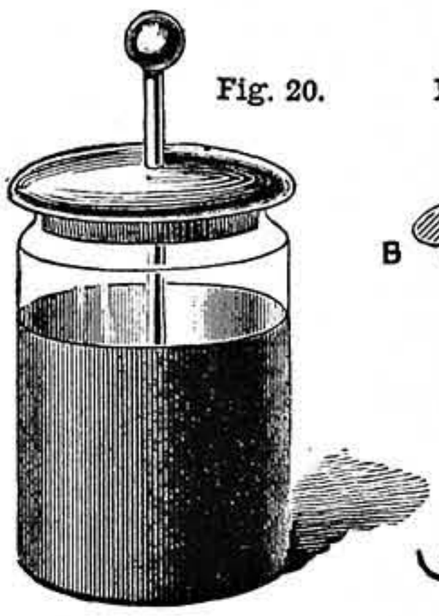


Fig. 20.

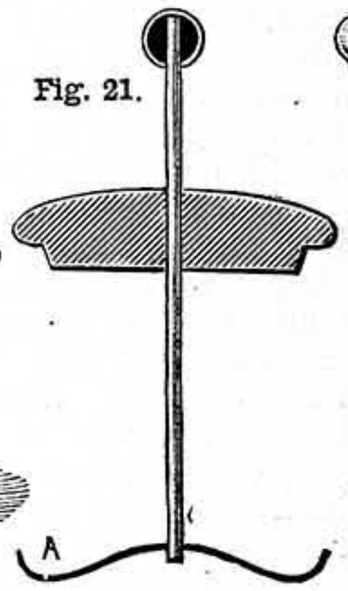
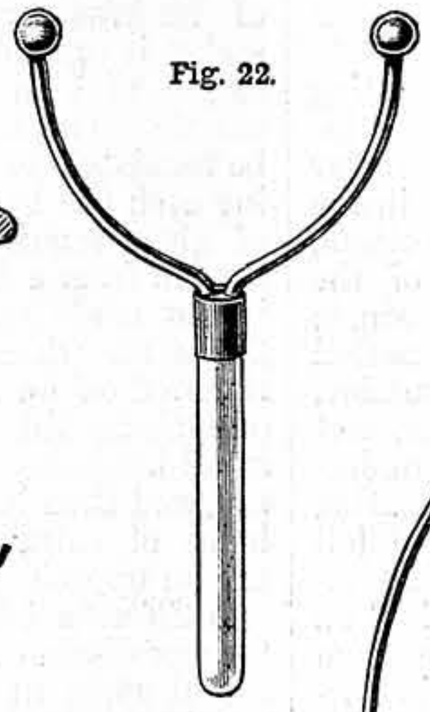


Fig. 21.



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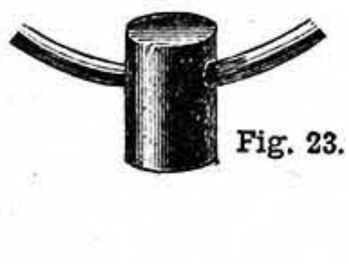

Fig. 23.

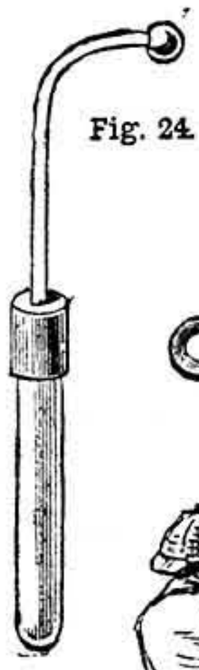

Fig. 24.

Fig. 26.

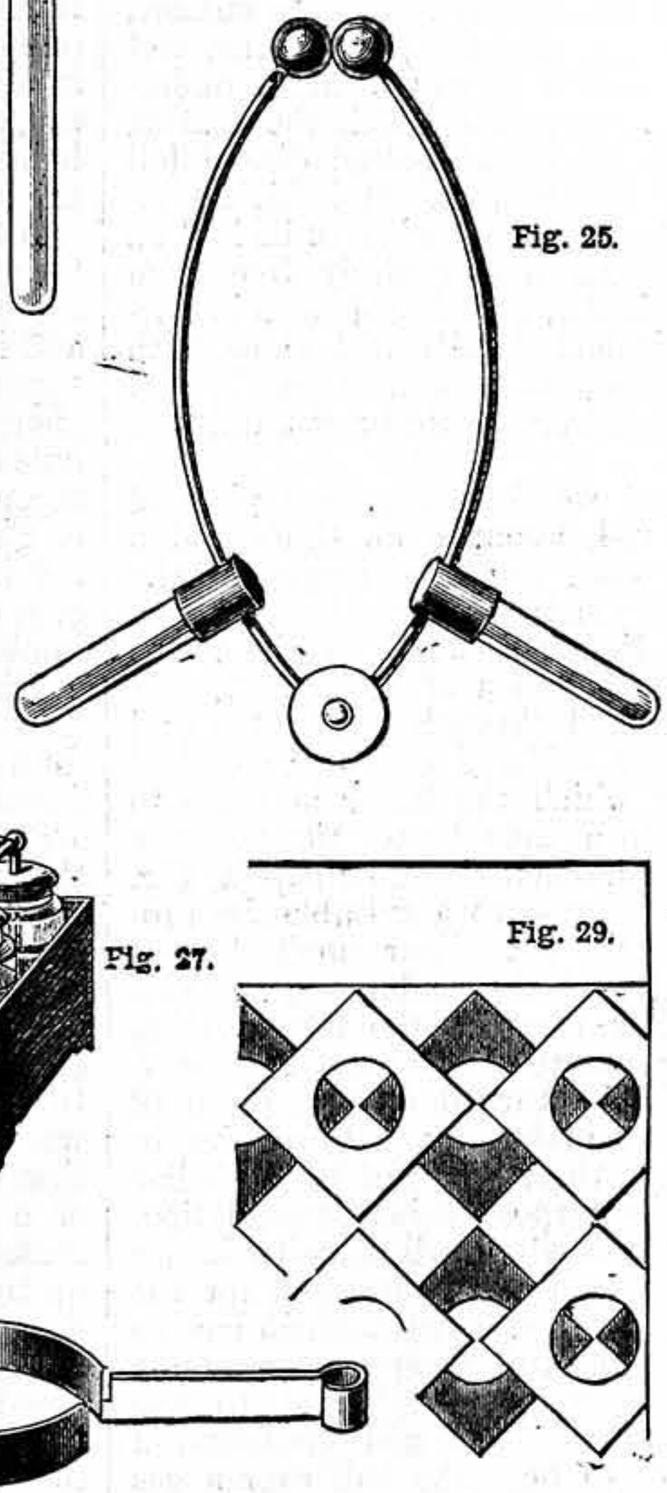

Fig. 25.

Fig. 30.

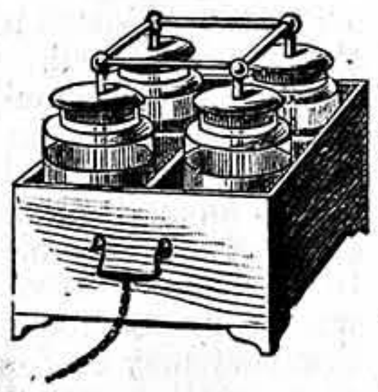

Fig. 27.

Fig. 29.

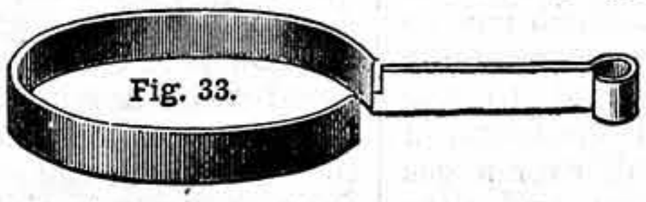

Fig. 33.

Fig. 28.

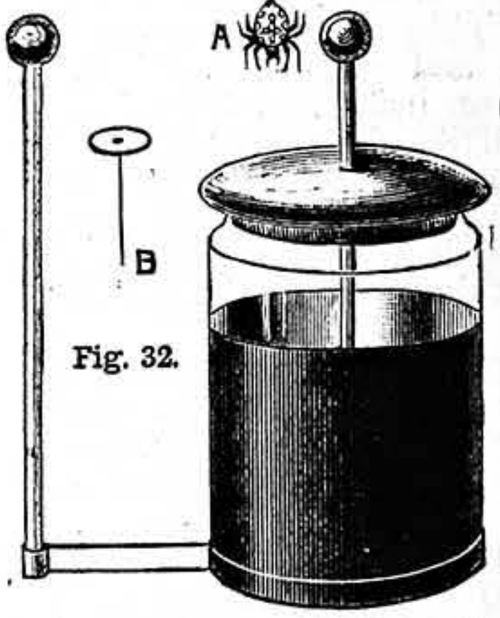

Fig. 32.

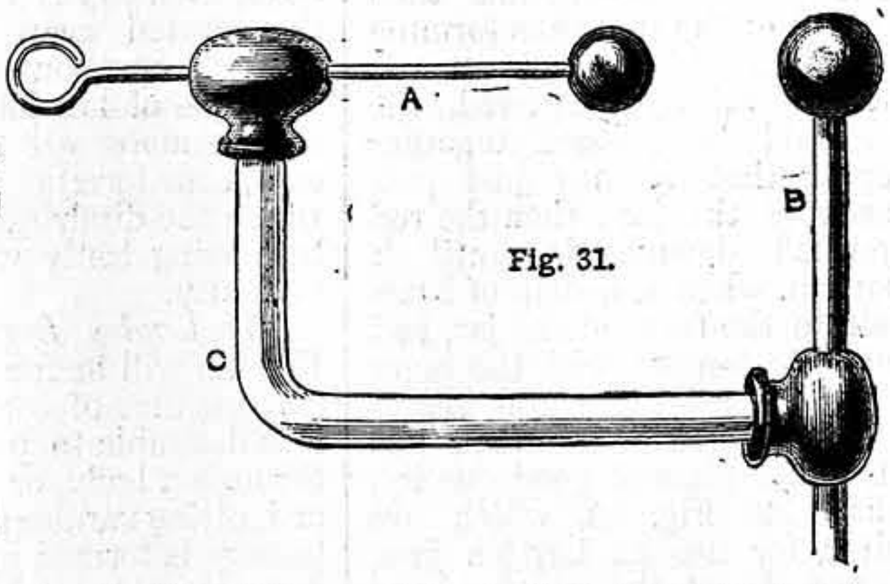

Fig. 31.

Fig. 19.—Brass Connecting Chain. Fig. 20.—Leyden Jar. Fig. 21.—Section of Cap and Conducting Fittings of Jar—A, Spring; B, Wooden Cap. Fig. 22.—Discharger. Fig. 23.—Alternative Plan for Cap of Discharger Handle. Fig. 24.—Director. Fig. 25.—Jointed Discharger. Fig. 26.—Arm of Jointed Discharger. Fig. 27.—Leyden Battery. Fig. 28.—Diamond-spotted Jar. Fig. 29.—Enlarged Detail of Diamond Coating. Fig. 30.—Sportsman Jar. Fig. 31.—Lane's Discharging Electrometer—A, Adjustable Stem; B, Stem of Jar; C, Glass supporting Stem. Fig. 32.—Spider Jar—A, Spider; B, Card Disc from which Spider is suspended. Fig. 33.—Brass Collar for Spider Jar.

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When in use, it is simply necessary to hang a chain from the loop of the adjustable arm, and then twist it round the base of the jar. It will now be readily understood that, by pushing the adjustable arm in or out of the insulated bearings, it will increase or diminish the distance between the two knobs, thus regulating the strength of spark obtained.

The Spider Jar (which is illustrated in Fig. 32) is an amusing method of slowly discharging a Leyden jar, which finds great favour with young folks. A suitable length of $\frac{3}{8}$ in. strap brass should be bent once round an ordinary Leyden jar, with 4 in. of the metal bent out at right angles from the jar. A slot is now filed from the upper edge to half the width of the metal just at the angle where the straight portion joins the ring, after which another slot is filed to a like depth at the extreme end of the ring, but from the under side, as will be seen by reference to Fig. 33, which represents the collar ready for attachment to the jar. By this means the ring may be bent round the jar and thus locked together securely. The extreme end of the straight arm is now bent in the form of a small loop, into which a stout brass stem is fixed in a vertical position by means of soft solder, a small brass ball being soft soldered to the upper end. A small piece of pith is now carefully cut and painted to resemble a spider (see A, Fig. 32), being provided with a few pieces of dried grass to represent the legs. When ready, it is suspended from the ceiling by means of a silk thread passed through its body and then knotted, the other end of the silk being passed through a hole in a small disc of card, to which it is secured by another knot (see B, Fig. 32). Thus prepared, the disc of card is gummed to the ceiling, with the spider suspended at a convenient height over the operation table. If the jar is now charged in the usual manner and then placed in position on the table, with the spider suspended between the two knobs, it will be alternately attracted backwards and forwards from one knob to the other, until the jar is finally exhausted.

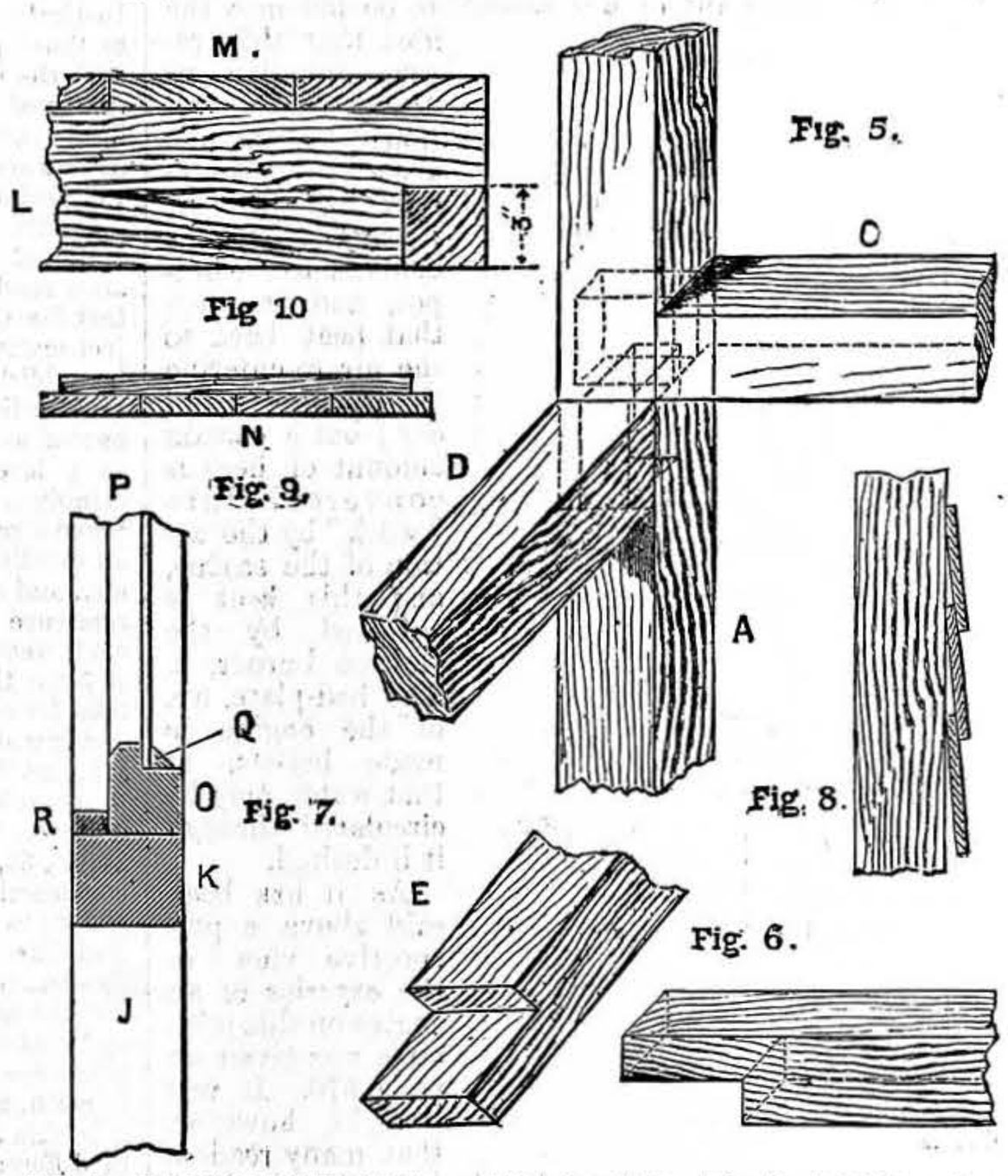

Fig. 5.—Relations of Uprights and Horizontals. Fig. 6.—Half Lapping. Fig. 7.—Fitting of Sash. Fig. 8.—Fitting of Boarding. Fig. 9.—Battened Door in Section. Fig. 10.—Flooring.

The above are a few of the articles which may be utilised as accessory apparatus to the Winter Electrical Machine. In the three papers to follow this I shall describe others, and thus put the reader in possession of the means and mode of making things which may be fairly described as electrical toys.

A CYCLE HOUSE.

BY J. H.

JOINTING AND FITTING—POSTS—HORIZONTALS—RELATION OF UPRIGHTS AND HORIZONTALS—FIXING POSTS IN GROUND—TOP FRAME—FITTING OF SASH—BOARDING—DOOR—FLOORING—FELT—TAR.

Jointing and Fitting.—I will now describe in detail the jointing and fitting of the various members of the house the general construction of which was shown in the previous article.

Posts.—Taking first the four uprights, A, A, B, B (Fig. 4, page 513), allow 2 ft. to go into the ground, pointing the ends with an axe. These ends will be either tarred or burned. The latter is the better method, and the operation simply consists in holding them in a wood fire for two or three minutes until the surfaces are charred and well blackened. They will then resist damp without rotting for a much longer period than if they were put into the ground without any preparation whatever.

Horizontals.—Into these uprights will be mortised the bottom horizontals, C, C, and D, D. Note that these are not on the same plane, but C, C, are higher than D, D, by the amount of their thickness, or their depth—3 in. There are two reasons for this; one is that better mortise and tenon joints can be made by this arrangement, because the tenons of C, C, and D, D, can go right through the uprights instead of meeting in the centre, as would necessarily be the case if the bars were in the same horizontal plane. The other is that the bars, C, C, form with L, L, good supports for the flooring boards.

Relation of Uprights and Horizontals.—Fig. 5 shows the relation of the uprights and their two horizontals. The making of tenoned joints has been frequently described in WORK, and I need not, therefore, occupy space therewith. For rough outdoor work no glue is used, but a tight-driving fit made between tenon and mortise. Some paint or tar may be smeared over, and the joints should be either wedged or pinned.

Before the tenons are finally secured into the mortises, it will be advisable to cut the mortises in the front horizontal, C, and in the end horizontal, D, D, to receive the tenons of the uprights, J, J, for the window-sash, G, G, for the door, and H, H, for the support of the boarding. Then, the main framing being thus prepared, the posts, A, A, B, B, can be driven into the ground.

Fixing Posts in Ground.—There is not, however, much driving required. The proper way to fix the corner posts is this:—Dig four holes, about 18 in. deep, in the positions to be occupied by the posts, and drop these—the bottom horizontals being already finally tenoned and fixed—into those holes. Drive them with a sledge down to a firm bedding—six or eight inches will be sufficient, dependent on the nature of the soil. At the same time, see that the horizontals lie quite in winding with one another. When this is done, shovel a quantity of small stones into each hole, and ram them tightly round the posts with a mason's rammer, or with a sledge, or other suitable implement. Earth may be afterwards thrown amongst the stones and rammed down.

Top Frame.—Prepare the top frame, either by tenoning the corners of E, E, and the outer bars, F, F, or by making a half-lapped joint (Fig. 6). Half-lapped joints will be held with screws or with wooden pegs. Tenon the cross-bars, F, F, into E, E. The frame will then be laid bodily on the uprights, and spiked firmly upon these with 5 in. nails. The verticals, G, G, J, J, H, H, may be tenoned into the top rails, E, F, F, or abut simply, and be fastened with 5 in. nails. This completes a good firm framing, to which the rest of the work has to be attached.

Fitting of Sash.—An old sash, bought of any builder, will be fitted between J, J, K, and E. The sash, of course, must be bought at first, and the frame made to suit. There is no difficulty in fixing. The size of the recess is the same as the outside dimensions of the sash. The latter is made to rest against strips nailed inside the recess. Fig. 7 shows this in section, where K is the horizontal rail, J a vertical rail, O the sash-frame, P the glass, Q the putty, and R the strip that keeps the sash in place. A few screws or nails, driven in diagonally, may unite the sash to the rails.

Boarding.—The $\frac{3}{8}$ in. boards on sides and roof are fastened with 1 in. wire nails to the frames; the overlaps are about 1 in. (Fig. 8).

Door.—The door, N, is made by battening 1 in. flooring board together, as shown in section, Fig. 9. It is hinged with strap hinges, not butts, and fitted with a staple for the padlock, a staple also being fastened into the post to correspond.

Flooring.—Two joists, L, L, to carry the floor, are fitted as shown (Fig. 10). The height of the shouldered portion is 3 in., equal to the depth of the quarterings of the frames. The boards, M, are then nailed on joists, L, L, and on frame timbers.

Felt is nailed on the roof with flat-headed nails, sold for the purpose. The house is tarred with two coats of tar. Shelving is put inside to carry oil-cans, spanners, and so forth.

HOT-AIR ENGINES.

BY FRANCIS CAMPIN, C.E.

IN the early days of steam engineering Mr. James Stirling pointed out the economy that might be expected from the use of

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heated air in place of steam in an engine. Subsequently Messrs. Ericson and Braithwaite took the matter up, and a steam vessel was refitted with caloric engines, as they were then called. This attempt was a failure—the late Mr. John Braithwaite told the writer that while the engine saved $10,000 in fuel, $100,000 worth of machinery was burnt out. This was in 1859.

Since that time many improvements have been made in hot-air engines, chiefly directed towards preventing the burning-out of the working cylinders, but on a large scale none of these have been successful.

Methods of applying water to the working parts have been used, but with the inevitable result of wasting fuel, for heat so abstracted must be a direct loss.

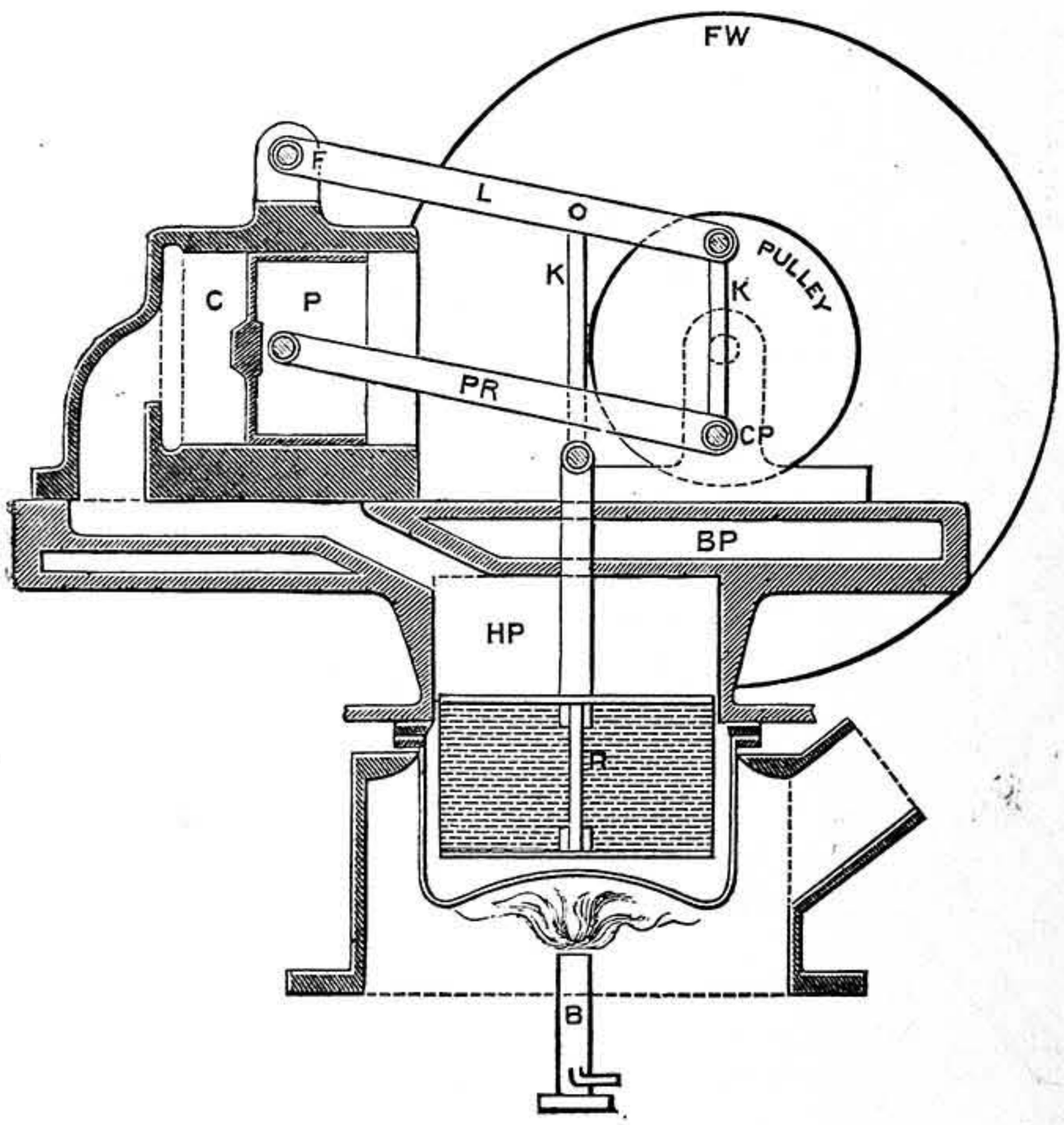
For small powers, however, there is a market for hot-air engines, and the best that I have seen is that made by Messrs. Potter & Co., in accordance with Robinson's patent. These engines may be driven by gas burners up to one-eighth horse-power, the gas being consumed in a Bunsen burner, so that there is no smoke whatever, or any escape of uncondensed gas.

A perspective view of the engine was shown in page 570, and the figure here given is a vertical section of the same. In this, C is a single-acting cylinder in which a trunk piston, P, works. The trunk piston is connected by a rod, PR, with a crank-pin, CP, fixed in a disc on a shaft which carries a fly-wheel, FW. Connected to the same crank-pin are links, K, K, which operate a rocking lever, L, and through links, K, K, actuate a plunger, R. The plunger, R, works in a hot-pot, HP, beneath which is a Bunsen burner, B. The rear end of the cylinder, C, communicates with the hot-pot, and the atmospheric air contained between these vessels is alternately expanded and contracted by the action of the regenerating plunger, R, and the burner, B. When the plunger, R, descends heated air passes up through the metallic gauze layers with which it is filled, and acts on the piston, P, which then makes a working stroke; the regenerator then rising absorbs the remaining heat from the air passing through it, and the momentum of the fly-wheel makes the return stroke.

These engines may be purchased at the subjoined prices :—

Nos.	Diameter of Cylinder.	Approximate Power.	Fuel recommended.	Prices.
	inches.			£ s. d.
1	1¼		Gas.	4 4 0
2	2½		,,	6 10 0
3	4	⅛ h.p.	,,	10 10 0
4	5½	1/16 h.p.	,,	16 10 0
5	7½	⅛ h.p.	,,	25 0 0
6	10	¼ h.p.	Coal or Coke.	33 0 0

This is a very interesting little engine, and is worth a little thought, especially in regard to the regenerator, R. I do not want any of our readers to be led into the idea that this regenerator gives us "perpetual motion;" it merely absorbs residual heat from the air passing from the cylinder to the hot-pot, and it gives that heat back to the air re-entering the working cylinder; but a certain amount of heat is converted into "work" by the action of the engine, and this heat is supplied by the Bunsen burner, B. The bed-plate, BP, of the engine is made hollow, so that water may be circulated through it if desired.



As it has been said above, a perspective view of the exterior of an engine on this principle was given on page 570. It was thought, however, that many readers of WORK would be desirous to obtain a description of the internal construction and arrangements, which was not given in the notice itself, and hence the appearance of the article and diagram by which the missing link is supplied.

OUR GUIDE TO GOOD THINGS.

*** Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of WORK for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of anyone who has a useful article for sale to obtain mention of it in this department of WORK without charge, the notices given partake in no way of the nature of advertisements.*

89.—FORTY PLATES ON BUILDING CONSTRUCTION. SOME time ago I had the pleasure of noticing in WORK some volumes of a technical character prepared and written under the auspices of the Polytechnic Institute, Regent Street, London, W., and published by Messrs. Cassell & Company, Limited, La Belle Sauvage, Ludgate Hill, London, E.C. I have now to draw the attention of the readers of WORK to a handsome folio volume entitled "Forty Plates on Building Construction," by Mr. Charles F. Mitchell, Member of the Society of Architects, Member of the Architectural Association, Lecturer on Building Construction at the Polytechnic Institute, and Registered Teacher of the Science and Art Department, and City and Guilds of London Institute. Mr. Mitchell has been assisted in his task, or rather in his labour of love, by the lecturers of the Polytechnic Institute. It will be useful to reproduce here at length Mr. Mitchell's prefatory remarks, which show far more clearly than anything I might write to this effect, the *raison d'être* of the work itself. "These plates," he says, "have been prepared to render assistance to students studying for the examinations in the elementary, advanced, and honours stages of 'Building Construction and Drawing' conducted by the Science and Art Department, and for the examinations in carpentry and joinery, brickwork and masonry, and plumbing of the City and Guilds of London Institute. I trust they will be found of service to those professionally or practically connected with the building trades. I also take this opportunity of thanking my colleagues for their help in the revision of those plates against which their names are placed, and to Messrs. E. G. Davey, Polytechnic Medallist, G. A. Mitchell, National Honours Silver Medallist, and F. G. Conyard, National Competition Prizeman, for the assistance rendered in executing the drawings. The text for the plates, together with additional subject matter and illustrations, will most probably be published early in 1892, under the title, 'Part II.—Building Construction and Drawing.'" Regarded as a whole, the volume may be described as a bird's-eye view of the various operations combined in the building of a house from the foundation to the completion of the roof, with all details of internal work in joinery, staircasing, etc., and all that is needful to be carried out with reference to plumbing, ventilation, and hot and cold water supply. To mention *singulatim et seriatim* the subject matter of each plate would take far more space than I have at my command, and it will be sufficient, while touching on this, to say that Plates 1 to 8, inclusive, are devoted to brickwork and masonry (1); Plates 9 to 22, and 25 to 29, to carpentry and joinery (2); Plates 23, 24, 30, 31, 32, to plumbing (3); Plates 33 to 37 to constructional ironwork (4); and Plates 38, 39, and 40 to details of a small town residence, with complete sets of working drawings illustrating fire-resisting construction, sanitation, ventilation, and the necessary arrangements for laying on hot and cold water in various parts of the dwelling. The price of the volume complete, strongly bound in cloth, is 10s. 6d., but those who do not require it in this form are privileged to obtain the plates in different sections, as described and numbered above:—No. 1 at 1s. 6d., No. 2 at 3s., and Nos. 3, 4, 5 at 1s. each; or copies of any single plate may be obtained in quantities of not less than one dozen at 1s. 6d. per dozen. This offers a great advantage to technical schools, in which this work will be found of the utmost service, and to classes in which any particular branch of the building trades is under consideration; and, owing to the number of students in the class, a single plate among so many would be well-nigh useless. The drawings themselves are well defined and clearly executed, and in all cases are drawn to, and accompanied by, a scale of feet showing the proportions of each piece of work, or species of work, that is illustrated, and affording facilities for enlargement, also to scale, a kind of practice in drawing office work that is extremely useful to and much needed by students. As a work of reference it should be found in the office of every builder whether on an extensive or limited scale, where it will also prove of service in reminding its owner and user of the right thing to do and the right way to do it, at times when through stress and pressure of work and the worry that is consequent upon it, the brain will not answer the helm quite so readily as it will when all is plain sailing and there is nothing to distract and weary and divide the attention.

THE EDITOR.

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SHOP:

A Corner for Those who Want to Talk It.

*** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Patent.—S. E. (*Upper Clapton*) writes:—"'It is amusing to see the readiness with which persons entirely ignorant of a subject will set themselves up to guide and instruct others, and what useful and infallible authorities they consider themselves.' In these words our friend C. E. commences one of his usual instructive and useful articles, on p. 492, No. 135, and his words are perfectly true as applied to the nonsensical and misleading statements made some time ago by C. C. C., and in other papers by many other would-be authorities in such matters. But C. E. has himself made a serious slip in the article in question, and I hasten to correct it, as if any of your readers rely upon this particular statement of his, they may regret it when too late. C. E. tells us (speaking of the filing of the complete specification) that, 'if it is found that what has to be done cannot be completed within that term (nine months), an extension of time of one, two, or three months may be applied for, for one of the three periods named, with the stamps for fees of £2, £4, or £6 impressed upon the application; but *no further* extension of time will be granted.' The fact of the matter is that one month, and one month only, beyond the original nine months, can be obtained for filing the complete specification, and the stamp duty required on the application form is £2. I am sure that C. E., in his usual fairness, will be ready to admit his error in the case. As an inventor myself, I have found that what you want is an old-established, experienced agent, doing business in a comparatively small way, and whose personal attention you may rely upon obtaining."

Patents.—S. G. T. (*Penarth*) writes:—"Many of your correspondents tell us novices how to go about getting a Patent, and in a very clear and able manner; and there is no doubt but that anyone of average ability could get his ideas patented by following their directions. Among other things, they tell us to go and search the Patent records before we apply for a Patent, and see if we have been anticipated. Now, I have what I believe is an excellent idea for a cushioned tire for bicycles, etc., and I went, before applying for protection, and searched the Patent lists to see if any other 'inventor' was before me. I looked through all the lists of sealed Patents for this year, but found nothing like mine, but on searching the lists of applications for Patents, I found that there were about two a day for the last three months for the same kind of thing. Now, can any of your correspondents tell how we are to know that some of these applicants may not have the very same thing as ourselves, and being before us, of course, have the preference? A little more information would be very useful upon this point, and doubtless some kind reader will supply it without appealing to your specialist for so small a matter."

Boot for Shortened Leg.—J. F. (*Glasgow*) writes:—"Could you kindly send me Mr. Tyrrell's address (see Work, No. 135, p. 490—Improved Boot for Shortened Leg), as I wish to make inquiries about above?"—[No addresses can be given in Work elsewhere than in the advertisement columns.]

The Utility of Work.—The Rev. L. M. (*Roscrea*) writes:—"I have often thought of writing to you to say how pleased I am with Work. It is a splendid paper for all professionals as well as amateurs, and I have tried to show my appreciation of its value by recommending my friends to subscribe to it. I am glad to say half a dozen, at least, have been wise enough to follow my advice, and they all agree in saying it is 'A 1.' I say this by way of encouragement, Mr. Editor—if you need any—though I think the success of Work ought to encourage the most despondent of editors, and I know *you* do not belong to that class. Now see what an advantage Work has been to me. Four years ago my 'kit' consisted of an axe, a rusty saw, and a sardine knife. But Work put different ideas into my head, and showed me the way to carry them out. First I made the Cheval Screen Escritoire. Then I took up the Battlesden Car—in spite of gloomy prophecies by my friends as to the result when the trial trip was made. Then came other things, among which I may mention folding table, two overmantels—one from design by Mr. Gleeson-White, the other by Mr. Adamson—a settee, wardrobe, dressing-table, and a dozen other things; the last a zither, which my wife is now playing. So you see Work has been a real source of profit to me to say nothing of the pleasure, and with regard to the last item, I have spent some of the happiest hours in my 'shop' I ever spent. I am not afraid now to tackle any job that lies in the carpentry line, for the reading of Work has been as good as an apprenticeship to me. I live within a dozen miles of one of your contributors, the Rev. J. L. D., who has been very good to me in giving me hints; and Opifex was once in this diocese. I must apologise for trespassing on your valuable time, but after all the pleasure and profit I have derived from Work, the least I can do is to write and express my gratitude."—[Insertion is given to this letter because it not only illustrates the extent to which the publication proves serviceable in the hands of the intelligent worker, but because it contains an excellent suggestion bearing upon the large circulation of Work. If the many subscribers who write anxiously desiring to "do something" for Work were to follow the Rev. L. M.'s example, there is no saying where the circulation of the Magazine would end.]

Framing Engravings, etc.—T. S. (*No Address*) writes:—"I so often see good engravings spoiled by careless framing that I am induced to send to your readers the way in which the work should be done instead of the usually imperfect mode. A valuable engraving is sent to be framed, and if nine out of ten are examined they will be found to be done as follows: The glass is put into the frame and strips of paper pasted round more or less carefully, thus the frame and glass are secured together; then the picture stretched on a frame, or stuck to a mount, is put in with a few brads, and brown paper stretched over all. The effect of this plan is that, however perfectly it is done, the act of cleaning the glass presses the brads down and loosens the paper that is intended to secure all dust-tight, and in the course of a year or two a brown streak of smoke-dust extends like a shadow across the picture, often impossible to remove again, or a general cloud veils the picture, causing a proof engraving to look like one of the last dozen prints taken off the plate. Now the proper way is to carefully clean the glass—and even in this some extra care is necessary, as brisk rubbing to a sheet of glass will make it electrical, and every particle of dust will fly to it, and require some trouble to remove—and you will find when the work is done, that your glass has a quantity of fibres of the cloth you used, or any other small particles that happened to be near, between it and the picture. Place the glass cleanest side up on the table, projecting an inch or two over the edge; lay the picture on it, and if it has no mount, a sheet of brown millboard, or at least a sheet of stout paper should be added. Then with a straight-edge cut some strips of brown paper of width sufficient to bind the glass and picture together (about ⅜ in. on the glass and ½ in. on the back); add to this the thickness of glass and picture. Damp the strips and glue them on to the edge, like what the ladies and tailors call binding; follow round all four sides, so that, when the work is done, all that is required is the ornamental frame, and something to hang it by. The picture, but for appearance, is perfectly dust-proof, and will always look bright and clean. It will sometimes happen that the frame has a very narrow rebate, and the binding will show, so when quite dry you had better pop it into the frame to see how it looks, and if any binding shows, run a pencil-mark round: take it out, and with straight-edge and point of knife, cut down through the binding to the glass, when the superfluous binding can be easily scaled off, leaving the glass quite clean. I have often had to leave only ⅛ in., but if properly done it is enough. Another piece of millboard, or a thin wood back, secured with a few brads and a damped sheet of brown paper glued over all, will make a complete job. Thus the frame is, as I have before stated, merely as a means of support and ornament to the picture, which, for protection against dust, etc., is completely framed without any frame at all. In fact, I have often stuck a strip of gilt paper on the glass over the binding, and glued a loop on the back and hung up small photos without any frame at all."

II.—Questions Answered by Editor and Staff.

Die Cutting and Stamping.—M. (*York*).—(1) I have made inquiries as to the presses you require; and, no doubt, you have received price-lists, etc., by post, as great pressure on the columns of "Shop" will prevent this appearing for some time. The "Model" Press Company, of Farringdon Street, E.C., have them in all sizes; and Mr. John Esson, of Fetter Lane, Engineer and Printers' Broker, has several, second-hand. The specimens of relief stamping are very good; the engraving of the dies, however, seems to me to be rather shallow, if anything. (2) The black composition for filling in door, window, or coffin plates, whether zinc or brass, is best black sealing-wax; and for red letters, best red sealing-wax. The plate should be heated till the wax completely fills up the cutting; then grind off all burr left by the tool, and all superfluous wax, with a stone and water first; afterwards polish with oil and crocus (finest emery powder), and, lastly, with whiting and oil.—J. W. H.

Type Cases—Soda Crystals.—No Name.—Mr. John Esson, Printers' Broker, Fetter Lane, E.C., will, I think, give you the information you want as to the half-cases you require, and, probably, has some second-hand ones in stock. Any large oilman, such as Mence Smith, would supply you with the soda.—J. W. H.

Paraffin Mixing.—W. S. (*Glasgow*).—It is a difficult matter to connect your bare inquiry with any purpose or calling; otherwise, to answer it usefully might be a more definite matter. A friend, who is an analytical chemist, tells me he would mix them by turning a current of steam into the paraffin, or that alcohol would help to effect the purpose. My own experience in trade matters may be more serviceable, perhaps, in your case. Water—preferably "soft" water—can be amalgamated with oil paint by a continuous "agitating" action; and hot oil and turpentine may be readily mixed with water-paint liquids in a similar manner. In both instances the purpose is effected sufficiently thoroughly for spreading the mixture upon flat surfaces. From this I assume that paraffin—*i.e.*, petroleum—could as readily be amalgamated with water, especially in the small proportion of the former you name. I expect equal parts, agitated in a bottle, would soon mix, and then could be turned into the bulk of water. If there is any special chemical article used in certain processes for assisting the mixing action, I should suggest *borax* as being the factor. Why not state, simply and openly, your object and purpose?—F. P.

Veneering.—Ivanhoe.—You cannot do better than read the articles on Veneering in Vol. I. of Work. They deal thoroughly with the subject, and, having so recently appeared, it is impossible to go over the ground again in "Shop." Of course, after reading them, if you find yourself in a difficulty, write us, and you may be assured every assistance will be given you; but, after the very lucid directions which were given about the side of the wood on which the veneer should be laid, I hesitate to say the heart side, in case you should still misunderstand which side. If you have not got all the back numbers of Work, and do not care to buy them—though I strongly advise you to invest a penny in an Index to Vol. I., so that you can see what subjects have been treated—you will find a "few hints" (much good may they do you, for I rather think you want full directions) on a sliding-frame dining-room table in the number of Work for 7th June.—D. D.

Distemper.—Beeswax.—The amount of *genuine* yellow beeswax which—having been already scraped into shreds and then dissolved in oil of turpentine—should be added to a half-bucketful of distemper, in order to make a *tempera* paint for good decorative work, would be about 4 oz; or for a good pailful, prepared according to the instructions quoted on p. 787, Vol. I., the proportions would be ½ lb. pure beeswax in 1½ pints of turps, the two well amalgamated, and then added as directed. Respecting your second query, sufficient finest isinglass to make a pint of glass-gilding mordant could be readily placed upon a shilling. For further information, see answer "Acid and Gilding," when published.—F. P.

Bell Telephone.—J. R. M. (*Walton*).—I do not know of any very cheap telephone which would answer your purpose, unless you like to use the apparatus called "The Lovers' Telegraph." It can be made with two empty meat tins. Remove the bottom of each, and, in lieu thereof, stretch a piece of parchment over the end; in the centre of these bore a little hole, and pass a cord or wire through them, connecting both tins together, with a knot or button on the inside of each. The string must be kept strained when the instrument is in use. Words spoken into one cylinder can be clearly heard by a listener at the open end of the other. This is really a mechanical telephone, and, if properly made and connected, would answer your purpose very well. But I think you should try and make a set of telephones, with transmitter and receiver at each end, such as have been illustrated fully in Work already. They are as cheap as any I know. Sometimes you know that a cheap thing turns out very dear in the end. As all the necessary connections, etc., have been given before, it is not worth while taking up space with rough drawings. And, as you are a constant reader, you will have no difficulty in getting what you want from back numbers.—W. D.

Micro-polariscope.—B. J. T. (*Southsea*) asks if the angle of 26°, as given in my article, is the correct one, and if it has been given from experience, as in Ganot's "Physics," 54° 35′ is stated to be the proper angle for glass to polarise. I will answer the last question first, and say that I arrived at my conclusions after long and exhaustive experiments, and the angle I have given is the one by which I have worked. From experiments I have made, I am led to think that the same angle does not answer for all kinds of glass, and, to obtain the best results, experiments must be made. Different writers seem to range from 50° to 60°. That being so, the discrepancy between such an angle and that given by me is only in appearance. Before I began experimenting, I read, "Glass will polarise at an angle of, say, 54°," by which I understood an obtuse angle containing 54°. I accordingly made a tube, and cut off the end at this angle; the result was, not the least polarisation. I was much perplexed thereat, and wondered where the mistake could be. I began experimenting, gradually tilting the glass at a more acute angle, until I obtained polarisation. I now found, by measurement, the angle at which I was working was just exactly the complement of 54° or 26°. I then understood that what was intended was that 54° were to be cut off. This is really the solution of the seeming difficulty. Having been

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perplexed myself in the matter, I thought it would simplify matters to say that the tube should be cut at an acute angle containing 26°.—O. B.

Planing.—J. R. (*Hillsborough*).—You give no clue as to your acquaintance with wood working; but, probably, it is of a very recent date. I could advise better if you had given fuller particulars. I join with our Editor and contributors in asking our querists to ask their questions very fully, giving particulars of the special difficulty that presents itself, in order that we, who are still learning, may learn to give full, exact, terse, and helpful replies. For planing pieces of wood ½ in. square, 2 ft. long, use a jack-plane, well sharpened and set. Read how to do this in WORK, No. 20. With proper treatment, the wood does not want *fixing* on the bench; but if J. R. has many pieces to plane to a size, it may be worth while to make some contrivance to assist in doing this. I have a paper in hand on this very subject, which I will send to the Editor as soon as I am able, and hope it will be of use to J. R. and many others.—B. A. B.

Cog-Wheels.—A. Y. (*Blackburn*).—When the saw bench on p. 177, Vol. II., was drawn, I thought chiefly of the most convenient height of handle, doing away with slip, and getting the advantage of a rapid revolution of fly-wheel. If these are obtained, by all means have the other details to suit yourself. I should apply for cog-wheels to Lloyd, Steelhouse Lane, Birmingham, or Barker's Gas Engine Manufactory, Birmingham. If not successful in obtaining the wheels, I should try to get a second-hand mangle and wringer, or the wheels thereof, by Bradford, or Harper Twelvetrees; but without sizes it is impossible to advise. It would be best to get two cog-wheels and two pinions before deciding position of axles, as the exact size does not matter much. You want the saw to turn at least twelve times as often as you turn the crank. —B. A. B.

Propeller Screws.—F. M. (*Thornton*).—The area of screw blades should be determined by experience; but for those who have no opportunity of so determining it the following rules will be useful. I give them for four-, three-, and two-bladed propellers. I H P = indicated horse-power of engines; *c* = a co-efficient:—

$$\text{Total area of screw blades} = c\sqrt{\frac{\text{I H P}}{\text{revoluts. per min.}}}$$

In which formula—

c = 15 for four-bladed propellers;
c = 13 for three-bladed propellers;
c = 10 for two-bladed propellers.

The pitch of screw for propellers varies very much, and in our columns we have not space to deal with so wide a subject. You will find it all explained in Seaton's "Manual of Marine Engineering." The thrust of screw is also explained in the work referred to.—F. C.

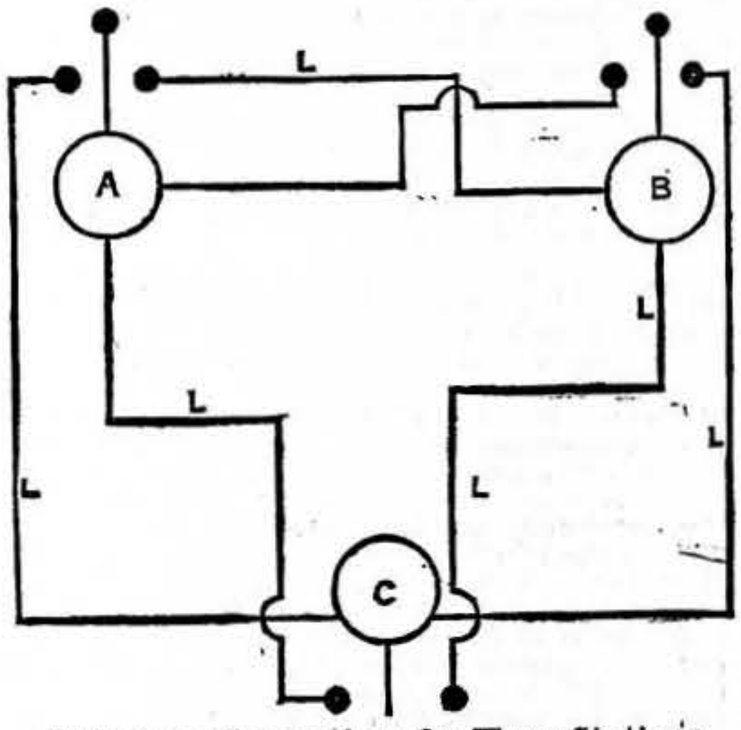
Steel Hardening.—A SUBSCRIBER.—No special method beyond the mere immersion of the articles to be hardened. The lead can be melted in any iron vessel; a ladle will do for small articles. The advantage of its use is that the temperature is nearly constant, and that the articles immersed can be left in the lead for an indefinite time without becoming burned. The steel is not oxidised as it is when put into the fire, but retains a clean surface. The lead should be free from corrosive adulterations, and be covered with charcoal while molten. Perhaps the following table, copied from a valuable and now rather rare book—Percy's "Metallurgy of Iron and Steel"—may be of service to you and others:—

TABLE OF THE COMPOSITION OF METALLIC BATHS FOR THE USE OF WORKING CUTLERS.

No.		Composition of the Bath.		Temp.
		Lead.	Tin.	Fah.
1	Lancets	7	4	420°
2	Other surgical instruments	7½	4	430°
3	Razors, etc.	8	4	442°
4	Penknives, and some implements of surgery	8½	4	450°
5	Larger penknives, scalpels, etc.	10	4	470°
6	Scissors, shears, garden hoes, cold chisels	14	4	490°
7	Axes, firmer chisels, plane irons, pocket-knives	19	4	509°
8	Table-knives, large shears	30	4	530°
9	Swords, watch-springs	48	4	550°
10	Large springs, daggers, augers, fine saws	50	2	558°
11	Pit saws, hand saws, some springs	Boiled linseed oil.		600°
12	Articles which require to be somewhat softer	Melting lead.		612°

Of course, a list of this kind must be taken *cum grano salis*, because of the great difference in qualities of steel. But the lead bath is valuable, nevertheless, and is used to a considerable extent. This ensures uniformity in tempering a number of similar articles; but where the clear fire only is used, the articles are enclosed in a cast-iron box, or a tube of cast or wrought iron, or laid upon a hot plate or bar. For small articles, a cylindrical tube of cast iron is as useful as anything.—J.

Telephone.—H. S. (*Stoke Newington*).—This is really a very simple matter when one thinks of it. Having fixed up your instruments in the various rooms, you will require three two-way switches. Carry a wire from station A through the switch to stations B and C. This done, go to station B, and carry the wire to stations A and C through another switch; and, having gone to station C, carry a wire through another switch to stations B and A, thus completing the arrangement. By following this out you will have complete control of the various instruments at the different stations. A simpler plan could not be adopted, although one which would,



Telephone Connections for Three Stations.

perhaps, save a few yards of wire might be devised; but it would lead to complications which would be difficult to get over. You will, of course, require a transmitter and receiver at each station, and also a bell for calling attention. I give above a sketch of the connections, although I think it is not necessary, for the instructions are plain enough, and would be easily carried out. In the sketch, A, B, C represent the three stations, and the heavy dots the switches. The arms of the switches are not shown. The L's represent the line wire. I hope you will be able to get over your troubles, and that your darkness will be illuminated by the above.—W. D.

Spirit Graining.—A. W. P. (*Leytonstone*).—Since your query was received, you have, doubtless, had a full answer in the paper devoted to the process which appeared in the Graining series, Vol. II. I should not advise you to try and make the paint mill, as they can be bought so cheaply of any painters' merchant. Crowden & Garrod, Falcon House, London, S.E., sell a very good one for 30s.

Paint Mill.

(I append illustration), which is computed to grind 6½ lbs. per hour. The next price is 40s., and so on up to 180s. To the trade, and for cash, there would probably be a reasonable discount off this. You cannot do better, I believe, than buy of Crowden and Garrod; but grinding one's own paint is poor economy at any time, unless one is situated far from manufacturing centres.—F. P.

Zither Tuning.—J. J. (*Belfast*).—You should write to the publishers, Cassell & Co., Limited, London, E.C., and enclose the necessary stamps for any copies of WORK you may require.

Dynamo Design.—H. D. H. (*Clevedon*).—If you are satisfied with the "mechanical details" of the design submitted to me, I very much fear you know little of the principles of dynamo designing. In the first place, the F.M.'s are badly designed. The channel is quite ⅛ in. too large, and the cores present an insufficient surface to the armature. The arch of the carcase should not be in one piece, but be slit, and the two pieces connected by a gun-metal bridge. Taking your own statement as being correct, the winding is altogether wrong. In a series wound dynamo, the armature resistance should nearly equal that of the F.M. In your machine the armature resistance is ·0078 ohm, and the F.M. resistance 3·130 ohms. Why have you put the wire on the armature in sixteen sections? Only one of these is effective for E.M.F. of current. You have only one yard of active wire on the armature, and this must be run at 5,000 revolutions per minute to develop an E.M.F. of 1 volt under the most favourable conditions. With a resistance of 3·130 ohms in the F.M. alone, you will get but a fractional amount of current in the outer circuit, even if the terminals are not short-circuited with a thick wire. Your best remedy now is to cut the arch of the carcase in two pieces, and connect the two parts with a non-magnetic bridge of gun metal or brass. Then see that one of the cores has a north polarity, and the other a south polarity. They should be wound in opposite directions to ensure this. You cannot alter the armature channel or tunnel, so must let that remain. Connect the armature in shunt with the F.M.'s and run it as shunt-wound dynamo at a speed of 5,000 revolutions per minute. Even then you will not get a powerful current from such a small and badly designed machine.—G. E. B.

Electric Light Manager.—T. (*Port Said*).—Your qualifications, as stated in your letter, should fit you for the duties of manager in an electric light installation. But you cannot expect an electric lighting company to take you on your own recommendation alone. I should therefore advise you to get your qualifications laid down on paper by your officers, and backed with the names of well-known men before you leave the service. Then you will have to make personal application to one or more of the electric lighting companies and ascertain whether they have a vacancy or not. Or advertise in WORK, the *Electrician*, or the *Telegraphic Journal*, for a situation. It is quite possible you may have to show your qualifications in the factory in a lower position, and thus work your way along by giving practical proof of your abilities. —G. E. B.

Iron Girder.—J. S. B. (*Poplar*).—The length of chord varies as the radius. We must first find the radius of the bottom chord, which is determined by dividing the square of span by eight times the camber, and adding half the camber: thus with span 75 feet, and camber 1½ inches (=⅛th foot)—

75 feet
75 „
375
525
⅛ × 8 = 1) 5,625 square of span.
5,625
⅛ = half of camber.
5,625⅛ feet = radius of bottom chord.
Add 8½ feet = depth of girder.
5,633⅜ feet = radius of top chord.
Multiply by 75 feet = length of bottom chord.
28,165
39,431
42⅜ = (75 × ⅛).
422,517⅜

This is to be divided by radius of bottom; the fractions may be dropped:—

$\frac{422,517}{5,625}$ = 75 feet 1⅜ inches, length of top chord.

You ought to allow 1 inch camber for every 40 feet of span. You will find the construction of girders practically treated in a series of articles on "Wrought Iron and Steel Girder Work," commencing page 171, Vol. I. of WORK.—F. C.

Beer.—W. G. G. (*London, S.E.*).—I am not aware of any book devoted specially to the after management of beers, but "The Theory and Practice of Modern Brewing," by Frank Faulkner, published at 21s., by F. W. Lyons, will be found to be an exhaustive treatise on the whole subject. The keeping qualities and condition of beers depend mainly on the quality of malt and hops used, and the skill with which the brewings are carried out. If any of these are defective, after management can do little to rectify and preserve. Thick and sour beer cannot be converted into good beer. The best judge of the quantity of finings is, in each case, the brewer who brewed the beer; different beers require different treatment. Warm weather undoubtedly affects beer, but beer can be, and is, brewed to stand such. Inferior qualities suffer most by the high temperatures.—APIS.

Harmonium Articles.—H. H. (*Barnsbury*).—No such papers have yet appeared, but some are in preparation.

Discs for Electric Belts.—J. W. (*Camberwell*).—I am not favourably inclined towards your proposed method of connecting the discs of copper and zinc. You are right respecting the dimensions of the discs. These may be of the size of pennies, or even larger, up to 1½ in. in diameter. You are also right about having a piece of flannel between the zinc and the copper discs, this flannel partition

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acting as a porous diaphragm between the two elements. Now, the two elements should be connected as the plates of a battery are connected, not by a brass eyelet in the centre, passing through the porous diaphragm, but by an insulated conductor conveyed from the outside of the copper discs to the outside or edge of the zinc discs. These should be next the body of the wearer, and coated with thin flannel to prevent actual contact of the metal with the skin, or sores will result from irritation by the metal and its salts. The perspiration from the body wil pass through the flannel, excite the zinc, and generate a current of electricity, which will pass through the moist porous diaphragm to the copper and be conveyed by the insulated conductor to the zinc of the next couple, and so on. When the two end discs are connected by the metal clasps of the belt, a current will circulate around the body. For further information I must refer you to "Shop," in Nos. 103, 115, 117, 120, 124, and 129.—G. E. B.

Electric Gas Lights.—GAS-L.—The instrument described by you, and illustrated by the sketches sent with your letter, is one of Clarke's patent electric gas lighters. The principles of its construction are similar to those of a Wimshurst frictional electric machine. Inside the outer fixed cylinder of ebonite there should be two quadrants of tinfoil, such as shown in your sketch, and six knobbed wires. Two of these wires should be connected to the tinfoil quadrants, two of them (opposite to each other) be carried up to form conductors for the outer circuit and connected to the insulated wires in the stem of the instrument, and the ends of the other two connected together. The connections may be made above the plate shown in your sketch, and these may be defective. They should be well insulated from each other, and may be improved by pouring melted paraffin on the plate. The inner or revolving cylinder has six strips of tin or copper foil on its inside surface. The spaces between these strips should be varnished with shellac (spirit) varnish, but do not varnish the strips of foil. When the cylinders are in position, the knobbed ends of the six wires must touch the strips of foil in the inner cylinder. The insulation of the outer cylinder may (as you suggest) be impaired. To remedy this, warm it before a fire, and paint it whilst warm with some of the shellac varnish, but do not coat the foils.—G. E. B.

Bronze Paper.—THORNHILL.—Write to Berry and Roberts, St. Bride Street, Ludgate Circus, London, E.C.—G. C.

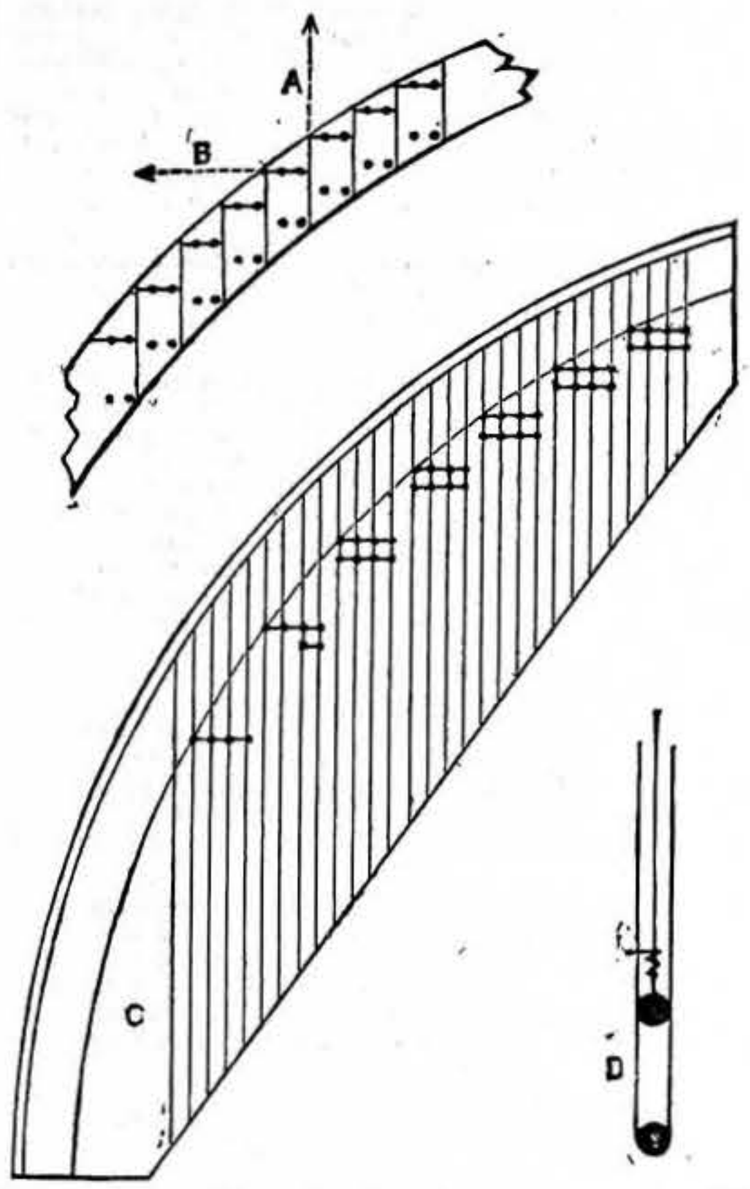
Small Dynamo.—H. H. (*Finsbury*).—As you are "only a starter at the game" of dynamo making, I should advise you to attempt something more simple and useful than trying to solve the problem of making "a small dynamo, weight about 1½ lb. complete, to fit in a box 3 in. high, 2½ in. wide, and 2 in. across," to give a light of 4 candle power when driven at about 2,200 revolutions per minute. I give your requirements here in order that some other reader may take up the problem and work it out for you if inclined to do so. As I do not think the "game" worth the candle, I relegate it to some one of those persons who find amusement in working out such problems. The "game," of dynamo making will require a little more study on your part than merely reading casually how to make a dynamo in the back numbers of WORK. I should advise you to read the instructions again, then "start" on one of the small dynamos mentioned on p. 644, Vol. II. of WORK. If you succeed with this, you will understand more about what you call a "game," but which is in reality a most serious study, than you do at present.—G. E. B.

Safety Bicycle.—J. J. (*Swansea*).—This subject has been treated in the following numbers of WORK:—107, 111, 115, 119, 124, 127, 132.

New Invention.—E. L. (*Netherton, Dudley*).—Our correspondent, as the matter is stated by him, is in no position to treat safely with the matter named; firstly, because there is no *proof* that he has any property to treat for; secondly, because he cannot *safely* treat for the sale of the plan until he has protected his rights, either by lodging a provisional specification or filing a complete. The first thing our correspondent should do is to ascertain clearly whether his invention *is* novel by a careful search and examination of all the published specifications relating to the subject, which may be seen at most of the public libraries—say, Birmingham, Manchester, etc. When he has satisfied himself that there has been no prior specification for his plan recorded at the Patent Office, he should then have prepared by competent parties, either a provisional or complete specification of his invention—properly illustrated with drawings in the latter case—and send them to the Patent Office, and when he receives the official notice of their acceptance, he may *then* proceed to negotiate for the sale or introduction of the matter. It would be the height of folly on his part to attempt to treat with anyone whilst his rights are unprotected, as it is too well known that what are called "trade" principles are not particularly noted for their abilities to distinguish the difference between *meum* and *tuum*, more particularly when the *meum* is most likely to be benefited by the operation.—C. E.

Boot Studs.—BARKIS.—E. Penton & Son, Mortimer Street, London, W., will supply you with Ellis's patent boot studs. There are three sizes, large, medium, and small—price, sevenpence per doz.; per gross, 5s. 6d.; keys, with awls, for same, 3d. each. I should think any large grindery warehouse near you would keep or get them for you.—W. G.

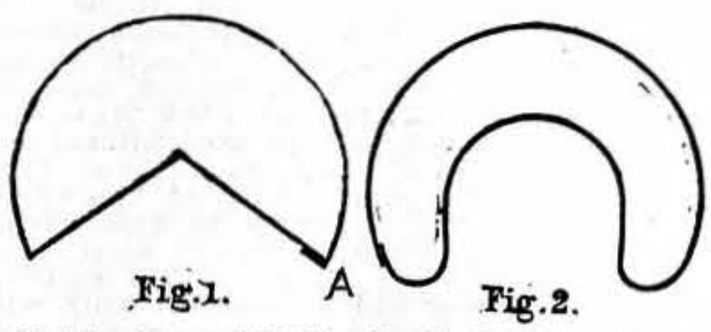
Piano Bent Side Plates.—W. H. M. (*Burgess Hill*).—It is quite correct what you have read. You make a line on the bent side 2 in. from the sound-board edge. You start your first parallel line where your 2 in. line crosses the vertical lines. Perhaps the accompanying sketch makes it more plain for you. If you read the paper on "Stringing,"



Sketch of Bridge—A, showing where cut with Saw; B, where cut with Chisel; C, how Hitch Pins are arranged on Bent Side; D, how Trichord Notes are formed.

in No. 41 of WORK, you will see why two rows of pins are needed for the trichord. If you cut a small piece of wood, and make the lines on it as described, you would soon see how the bridge is carved. The bridge is cut away on the bevel towards the sound-board, to free the string up to the bridge pin-holes. The string must be free between the bridges, from pin to pin.—T. E.

Charcoal Furnace.—T. J. W. (*Stoke Newington*).—According to your sketch the charcoal *ought* to burn. There are two things that might hinder it: one is that the whole thing is too small to burn, as you can only get a small quantity in—scarcely enough to keep alight; the next thing is that a solid bottom would be better than bars in this case, and cut a little off the bottom of the door for draught, or punch some holes in it. You ought to use very small pieces of charcoal, and light it before putting in; but if I were you I should use a spirit-lamp. You would get more heat from it, and it would be constant as long as the spirit lasted.



End Sections of Boiler for Model Steamboat.

Your boiler is wrongly constructed. You have got most of the water at the bottom, where there is no heat. I send you sections of two boilers, either of which I have found to answer well. Fig. 1 is very simply made of copper, double-seamed and soldered at A, and an edge thrown off at the ends, the ends put on, hammered down, and well soldered. They will stand any amount of pressure that you are likely to want for model engines of any kind, and there is no fear of them leaking while there is any water in them. Fig. 2 can be made in the same way, but the working is a little more difficult. I hope that these few hints may get you out of your difficulty. If any further information is required, I shall be pleased to give it.—R. A.

Pattern Cutting.—A. M. W. (*Dublin*).—There is a book called "Last Fitting and Pattern Cutting," a modern (1885) treatise on boot and shoe manufacturing, by A. Hannibal, St. Bride's Avenue, Fleet Street, E.C.; post free, 3s. But I should think the one to suit you best would be (if you will allow me to judge for you) "A Manual of Boot and Shoe Manufacture," designed for the use of technical teachers and students, by Hill & Yeoman, and published as above; post free, 4s. I recommend this book because you also ask for a book on the "technical terms" of the trade, and this one embraces not only pattern cutting, but subjects from the anatomy of the foot to prime costing; it also gives a good description of terms used in about fifteen subjects connected with the boot and shoe trade.—W. G.

Hand-sewn Boots.—A. B. (*Manchester*).—Your first question is one that concerns almost everybody, for through want of knowledge in being able to judge a hand-sewn boot from a machine-sewn, the public, by unscrupulous tradesmen and salesmen, are often greatly defrauded by the misrepresentation of goods. To answer this question to your, and my own, satisfaction, I should have to give one or two diagrams of sectional parts of boots of both makes, which would, with a proper description (which the subject deserves), make it too long for the "Shop" column. I will, therefore, as soon as time will permit, submit a short article on this subject for the Editor's kind approval. But, in the meantime, I will give you one or two hints that will help you in the matter. First take the sock out, and if you can see the stitches all round the inside, on the inner sole, you can be sure they are machine-sewn; if they are smooth, they are either hand-sewn, standard-screw, or a combination. If they are standard-screw, you will find the marks on the inner sole of a small round disc. The screw wire is put in to such nicety that they seldom show on the inside, but if the centre of this impression is scraped away with the point of a knife, the brass screw wire will soon be brought to light and prove the make. Or they may be a machine-sewn welt (the nearest approach to hand-sewn), but in either case you may be able to see a real and good stitch all round the outside. Machine-sewn boots or shoes are much heavier than hand-sewn. But another pretty sure guide is the inside of the heel, for as most all machine-sewn work has heels that are put on generally by a heeling machine, you can either see the heads of nails, or where they are clenched, on the inner sole of the seat, and if they are not machine heels they are nailed on by hand, and can be told in the same way: for this reason they often have a whole or half inner sole in them, but if taken out it can soon be replaced. Hand-sewn men do not build theirs in this way, for if not sewn they are pegged. Your second query, with regard to sewing the patch, see from A to B (Fig. 4), p. 201, No. 117, Vol. III. of WORK. You must not scrape kid, as that is a leather that has the grain side for the face. Calf you can, as the grain side is the wrong side, and the flesh the face. In answer to your third, I am pleased to tell you that my sixth paper, on Repairing, deals with welting and soling hand-sewn boots, which appeared on page 515 (No. 137).—W. G.

Carriage Alarm Clock.—ANSONIA.—I am afraid you will be unable to get the parts which you have broken and lost, as I have never been able to get exactly the same. The only thing I can advise you is to write to Grimshaw & Co., Goswell Road, Clerkenwell, London, and if they cannot supply you, then you can only put the remains aside as useless, or to come in for repairs, etc., to others of the same make; or you can write to the wholesale house of the company, or to the company themselves direct, and ask them to supply you with 'scape wheel, pallets, and staff complete. I am sorry I cannot assist further, but they are made so cheap that it does not pay to stock parts.—A. B. C.

Grandfather's Clock.—P. R. (*Edinburgh*).—I am of opinion that you have either forgotten to put on the gathering pallet—that is, the little part that picks up the rack when it falls at the hour—or if you got that on (which fits on the end of a squared pivot of the wheel next above the wheel with the pins in it, and which lifts the hammer), you have not got the rack hook on—that is, the part that holds up the rack, or if on, it may not be working as it should; or, again, you may have it on all right, but, perhaps, the rack arm that rests on the snail, or should do so, may be bent out and falls above and over the snail, and so falls too far, and the gathering pallet cannot reach it to pick it up. See that all the above are right, that the rack does not fall beyond the reach of the pallet, and that the rack hook holds the rack up when it is gathered at the same time. Put the pallet on so that the hammer shall be free or off the pins when the tail of the pallet is resting on the pin in the end of the rack.—A. B. C.

Chapel and Class-room.—G. S. (*Glasgow*).—We cannot give contributors' addresses, but any stamped and sealed communication can be forwarded. Why not ask your questions through "Shop" for the good of the readers?

Tar Stains.—X. W. I. (*Portsmouth*).—The simplest remedy I can advise you to try would be to well wash the stains with spirits of salts well diluted with water. If this does not move them, try some quicklime spread over them thickly, like a paste, and left for twenty-four hours, the lime having been previously slaked with water to the consistency of cream. Whichever remedy you adopt, it must be *very thoroughly* rinsed off with water.—E. D.

Core Box.—G. B. E. (*Coseley, near Bilston*).—A paper on Helical Wheels is being prepared, and will be published shortly.

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III.—Questions Submitted to Correspondents.

Brass Castings.—Brass Finisher asks :—"Can any reader of Work tell me where I can buy a set of castings for a good brass fender and fire brasses?"

Cement.—Repairer writes :—"Will A. S. P. or others give a receipt for bicycle cement with proportions? I hear that old tires are used with other mixtures; what are the other things? I have some old rubbers."

Wheat Mill.—P. E. (*Cupar, Fife*) writes :—"Can any reader of Work give me a sketch of the cutters used for grinding coarse oatmeal? I have got a mill for grinding fine oatmeal, but find the same will not do for coarse oatmeal."

Restoring Leather Chair Seats.—Incrêdule writes :—"Will A. J. (*Faversham*), who in p. 462, No. 133 of Work, recommends Jackson's varnish stains for above-named purpose, let your readers know where that material may be procured, as I would like to try it?"

Banjo.—Constant Reader writes :—"I am making a German-silver banjo; can anyone inform me how the edge is spun over the steel wires, also the easiest way of riveting it? I also want to engrave it. If any one of your readers can inform me the simplest way, he will oblige."

Upholstery.—W. W. (*Notting Hill*) writes :—"Will any reader give me some information how to stuff dining-room chairs, for I find when I make the roll and have stitched it, it is very uneven all the way round?"

Whip Stand—Spring.—Flagellum writes :—"Could any reader kindly give me an idea for a combination riding and driving whip stand? I should like it to be about 6 ft. high by 2 ft. 6 in. broad, standing on the floor against a wall, and containing a drawer for gloves, and so arranged that the riding whips might lie horizontally on hooks, and the driving whips might be upright. I should be glad to know, also, if there is any invention existing which is an improvement on the ordinary springs which are used for holding billiard cues, etc., in a vertical position in a stand, and which I find to scratch the cues, even if provided with rollers."

Rope Door Mats.—J. A. (*Southwark*) writes :—"Would any correspondent inform me how to make rope door mats? I have seen them oval shape, which I am told are made from old rope. I have pricked a hole through canvas and put the rope through, but it is not satisfactory. A rough drawing would greatly oblige."

Wooden Horse.—Old Chip writes :—"Could any reader tell me where I could get a wooden horse for a tricycle for a boy—a horse something like the hobby-horses we see going about?"

Frames, Mounts, etc.—T. B. (*Rochdale*) writes :—"Will any of our brother readers kindly give me the names and addresses of one or two wholesale houses in Manchester dealing in picture frames, mounts, etc?"

Transfer Drawings.—Draughtsman writes :—"Can any of your numerous readers give me any advice as to the making of transfer drawings for zincography? I use a crow-quill pen and Winstone and Sons' ink (litho transfer in sticks), but I do not know what consistency to make the latter. To get it a nice black I have to make it so thick that it will not work easily, and if I make it work easily the lines are faint in places. The crow-quills, too, seem to scratch up the surface of the prepared paper and blob the pen, making thick, smudgy lines where I want fine ones. The process is not photo-zincography, but the drawings are transferred direct from the prepared paper to zinc. I should be glad to know if there are any remedies for the defects I have mentioned, the best materials to use, etc., or if it is my own clumsiness."

Exotics.—Ajax writes :—"Can any reader of Work kindly inform me where to obtain any manual on the manufacture of artificial exotics?"

Engine.—Young Engineer writes :—"Will some reader give me a hint as to the colours to paint an eight-horse horizontal engine—such as cylinders, fly-wheel, and other parts? also colour for lining to match? Which kind of paint, too, ought I use to a ten-horse vertical boiler, or would gas tar do?"

Fret Machine.—N. R. (*Yeovil*) writes to W. R. S. (see No. 133, page 461) :—"Kindly tell me how to make a fret-machine saw, to fix to a table or bench."

Monogram for Fretwork.—N. R. (*Yeovil*) writes :—"Will some kind correspondent give me a NR monogram for fretwork?"

Chuck.—Young Turner writes :—"Would any kind reader tell me how to make chuck, for oval turning out of wood? If Mr. Blackett could give me any information I should be very much obliged."

Cement or Glue.—J. H. P. (*Blackpool*) writes :—"I want to make a flexible waterproof cement, suitable for applying to leather. The cement must stand 130 deg. Fahr. of heat without softening. Can any readers of Work assist one in a fix?"

Paraffin Oil Stove.—Solder-Pot writes :—"Can any brother reader inform me if a plumber's metal-pot and solder can be heated by paraffin oil?"

Spirit Stand.—Carr Dyke writes :—"Can any reader of Work give me a design, or particulars as to where I can get fittings for spirit stand?"

IV.—Questions Answered by Correspondents.

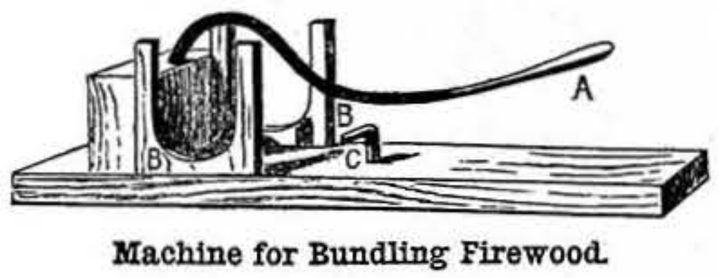
Locks.—Brass writes that if J. G. (*Bloomsbury*) (see No. 134, page 478) will apply to the undermentioned, he will in all probability get what he requires :—Mr. Wakeman, St. John's Square, E.C.; W. Taylor, Tower Street, E.C.; Thos. Ray, Waterloo Road North; all of Wolverhampton.

Model Steam Launch.—R. R. (*Liverpool*) writes, in reply to A. M. C. (*Holywood*) (see No. 135, page 494) :—"I should advise you to write to the engineering firm, Leop. Tolch, of Liverpool, who will give you every information about launches. The above firm are supplying also petroleum launches (pat. captain), which have met with general approbation, and have been considered even better than steam launches."

Wood Mole Traps.—J. T. and Sons (*Ulverston*) write, in answer to J. J. (*Cumberland*) (see No. 135, page 492), that they "make them one of their leading lines."

Heating Room.—H. J. L. J. M. (*Ealing*) writes, in reply to C. J. P. (*Derby*) (see No. 133, page 462) :—"I should think that for a room of the size you name (8 ft. by 5 ft. by 9 ft.) the duplex burner, if lighted an hour or an hour and a half before you require to use the room, would give out quite sufficient heat. I saw a lamp the other day called 'Lampe Veritas,' which gave out, according to size, twenty-five or fifty candle power. It was so arranged that the lamp could be placed in a radiator of cast iron for warming purposes, or put on a table for lighting purposes. This lamp is extensively used in country places for warming and lighting purposes. I should avoid the quicklime plan: it is used by workmen in the open air, but I should not like to try it in a room so small as described by C. J. P. It may be well to advise C. J. P. to see carefully that his room is suitably ventilated, or his studies may suffer and himself too."

Firewood.—F. H. (*Streatham*) writes, in reply to F. B. (*Rochdale*) (see No. 134, page 478) : "I have sent a sketch of a simple firewood bundling machine, which I hope will be plain to F. B. A is an iron lever; when the wood is put into the round bars, B, the lever is pressed down under the catch, C;



Machine for Bundling Firewood.

a counter weight or a spring will bring the lever up again when the bundle is tied. In Vol. I., No. 11, page 171 of Work, under the heading, 'Our Guide to Good Things,' there are illustrations and description of 'Machinery for Splitting and Bundling Firewood,' which I am sure will be useful and interesting to F. B."

Paper for Stencil Plates.—G. P. (*Elgin*) writes :—"In Work, page 459, Vol. III., I see a reply under the above heading by S. W. I do not think S. W. will resent my sending the following: I have no wish to contradict him in what he says, for the simple reason that I couldn't, but I believe that the substance I am about to name is better than either of those which he suggests. This material is Willesden 1-ply paper. It is a thin substance, although it possesses good body, and is by no means easily torn; it is easily cut, and it does not absorb much moisture. It is to be had from the Willesden Paper and Canvas Works, in various colours at various prices."

Coating for Damp Walls.—G. P. (*Elgin*) writes :—"Under the above heading The Author of 'Every Man his Own Mechanic' recommends R. A. P. to use a solution of naphtha and shellac (see No. 133, page 462). Now, without going to contradict such a high authority, allow me to suggest a material which may be used without the unpleasant smell of the naphtha solution. That material is Willesden paper. All substances which have been used as lining papers for walls where damp would be likely to injure the paper have been superseded by this paper, which is made by the Willesden Paper and Canvas Company, and is much cheaper. These papers may even be used by themselves, being supplied in certain colours, besides admitting of being coloured. For lining damp walls, either the 2-ply 54. in. wide, at 1s. per yard run for brown, 1s. 4d. for neutral green, and 1s. 6d. for extra brown; or the 1-ply 56 in. wide, at 6d. per yard run for brown, 9d. for extra stout, and 8d. for neutral green, is recommended. I derive no benefit whatever from thus bringing the paper under notice, except the satisfaction I feel from letting others know of a good thing."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure :—J. H. (*Manchester*); R. T. (*Paisley*); W. G. S. (*Manchester*); Cycles; A Reader; J. T. (*London*); H. S. G. (*Fulham, S.W.*); R. H. H. (*Merriols*); M. D. C. (*Liverpool*); Lux in Tenebris; F. W. (*Kingsland, N.*); Markwell; J. J. M. (*Liverpool*); Centre Board Canoe; Bellows on Three Legs; R. M. B. (*Glasgow*); G. W. (*Chelsea*); W. J. (*Heaton*); W. P. (*Withington*); Gum; A. B. G. (*Ascot*); A. T. L. (*Gloucester*); A. M. L. (*Nuneaton*); J. E. (*Cardiff*); Leghorn; H. B. S. (*Liverpool*); A. H. (*Hyde*); A. N. (*Bexhill*); Grinding-stone; New Reader; Stonemason; J. C. F. (*Coalbrookdale*); J. C. K. (*Lisson Grove*); Lance Jack; H. B. (*Accrington*); G. H. (*Leith*); R. T. (*Oldham*); W. R. W. (*Fulham*); W. J. H. (*Reading*); One in a Fix; W. H. S. (*Birmingham*); Knarr.

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